Engineering Library

JUN 30 1927

The Engineer.

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VOL. CXLIII.—No. 3727] LONDON: FRIDAY EVENING, JUNE 17, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 30th June, 1927, for ATMOSPHERIC STEAM HEATING of the New Garage Extension, P.O. Stores, Studd-street, Islington, N.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners of H.M. Works, &c.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5698

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. DRAW GEAR, SHACKLES, &c., for ROLLING STOCK.
2. 5220 AXLE-BOXES for CARRIAGES and WAGONS.
3. HELICAL and VOLUTE SPRINGS for ROLLING STOCK.
4. METALLIC and LAVATORY FITTINGS for RAILWAY CARRIAGES.

Tenders due on the 1st July, 1927, for Nos. 1 to 3, and on the 5th July, 1927, for No. 4.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 5747

Assistant Engineer Required by the GOVERNMENT of KENYA COLONY for service in connection with the Mombasa Town Planning Scheme for a tour of from 20 to 30 months' service, with possible extension. Salary £660, rising to £720 a year by annual increments of £30. Free quarters and passages and liberal leave on full salary. Candidates, aged 30 to 38, must be A.M.I.C.E. or hold equivalent professional qualifications and have had thorough experience of municipal engineering and macadam roads.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15029. 5697

Civil Engineer Required by the GOVERNMENT of BRITISH GUIANA for the PUBLIC WORKS DEPARTMENT for two years' service, with possible permanency. Free passages. Salary £600, rising by annual increments of £25 to £650. Candidates, aged 30 to 35, must be Corporate Members of the Institution of Civil Engineers and have been engaged since the completion of articles on engineering works for at least six years. Should be capable of designing and carrying out buildings, bridges and other structures and taking out bills of quantities and of preparing detailed estimates. Experience in reinforced concrete design is desirable. A fair knowledge of mechanical engineering, particularly with regard to internal combustion engines, is necessary. Preference will be given to candidates who have had experience abroad in the handling of native labour, preferably in a British Colony.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, quoting M/15411. 5700

The Government of India REQUIRE the SERVICES of an INSPECTOR OF CASTINGS for the INDIAN STORES DEPARTMENT. Qualifications :—Age 25-35 years; apprenticeship with a well-known firm of pipe founders; sound knowledge of moulding generally; thorough knowledge of inspection of cast iron pipes and especially of those made under British standard conditions essential; should have held responsible position in an up-to-date works.

Five years' agreement in first instance. Pay at the rate of Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 per calendar month. Free first-class passage to India. Provident Fund.

Forms of application and further particulars may be obtained (upon request by postcard) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 2nd July, 1927. 5726

Crystal Palace School of Practical Engineering, Founded 1872. MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E. PRINCIPAL: MAURICE WILSON, M.I.C.E.

Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years. Students admitted at beginning of any term. 5189

University College of Swansea. The Council of the College invites APPLICATIONS for the POST of ASSISTANT PROFESSOR of METALLURGY. Salary £750 per annum. The appointment will date from the 1st September, 1927. Further particulars may be obtained from the undersigned, by whom applications must be received on or before the 2nd July, 1927.

EDWIN DREW, Registrar.

Singleton Park, Swansea. 5652

The Institution of Structural Engineers. EXAMINATIONS FOR GRADUATESHIP AND ASSOCIATE-MEMBERSHIP.

The next Examinations for Graduateship and Associate-Membership will take place in London, Bombay, and such other centres as may be arranged on WEDNESDAY, JULY 6th (G), THURSDAY and FRIDAY, JULY 7th and 8th (A/M). Syllabus and form of entry from the undersigned. Closing date for entries, Wednesday, 29th June.

MAURICE G. KIDDY, F.I.S.A., Secretary.

10, Upper Belgrave-street, S.W. 1, 14th June, 1927. 5730

The Engineer

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PUBLIC NOTICES

The Institution of Structural Engineers. PUBLICATIONS IN JUNE, 1927.

COMMITTEE REPORT ON STEEL WORK FOR BUILDINGS. PART I., LOADS AND STRESSES. In a Foreword appears a letter from the Clerk to the L.C.C., which states: "... the Report ... contains much that is in accordance with the practice followed at present in the investigation of designs for steel work for buildings submitted for the approval of the London County Council. ..." The price of the Report is three shillings and sixpence.

PART II. of the Report, dealing with STEEL WORK CONNECTIONS: (A) Eccentrically Loaded Rivet Groups; and (B) Connections, Beams to Beams, is also published, price one shilling and sixpence.

REPORT ON LOADS AND STRESSES FOR GANTRY GIRDERS.—The Council of the Institution has also sanctioned the issue of this Committee Report, which is on sale at the price of sixpence.

EXHIBITION OF DESIGNS.

The thirty completed sets of designs submitted in connection with the Brenforce Travelling Scholarship (value £300, awarded in 1927) will be on exhibition at the headquarters of the Institution for a fortnight from and including Monday, 20th June. Members of kindred Institutions who may be interested are invited to view the designs any day between the hours of 11 a.m. and 5 p.m.

MAURICE G. KIDDY, F.I.S.A., Secretary of the Institution.

10, Upper Belgrave-street, S.W. 1, 15th June, 1927. 5744

City of Liverpool. TO ENGINEERING CONTRACTORS.

The Corporation invite TENDERS for the ENGINEERING WORK required at Public Washhouse, Lodge-lane.

Plans, specification, and form of Tender may be obtained on application to the Engineer and Chief Superintendent, Baths Department, 75, Dale-street, on payment of One Guinea, which will be returned on receipt of bona fide Tender.

Tenders must be enclosed and sealed up in the official envelope provided, addressed to the Town Clerk, Municipal Buildings, Liverpool, endorsed "Tender for Engineering," and delivered by letter post not later than Noon on Thursday, the 14th July, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

WALTER MOON, Town Clerk.

Liverpool, 14th June, 1927. 5732

PUBLIC NOTICES

Administrative County of LONDON. PAINTING WORKS.

The London County Council invites TENDERS for the CLEANING, REPAINTING, &c., of :—

1. BATTERSEA BRIDGE.
2. CHELSEA SUSPENSION BRIDGE.
3. PUTNEY BRIDGE, CHALK FARM-ROAD BRIDGE, and MITRE BRIDGE.
4. VICTORIA EMBANKMENT, ALBERT EMBANKMENT, CHELSEA EMBANKMENT, GROSVENOR-ROAD and DOCK BRIDGES.

Persons desiring to submit Tenders for all or any of these works may obtain the specifications, bills of quantities, forms of Tender and contract, &c., on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment in each case of the sum of £1 by cheque or draft to the order of the London County Council. This amount will be returnable only if a bona fide Tender is sent in and not subsequently withdrawn. Full particulars of the works may be obtained on personal application and the contract documents may be inspected before payment of the fees.

The contractors will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 4th July, 1927, will be considered. The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX, Clerk of the London County Council. 5737

Great Southern Railways. The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of :—

POINTS AND CROSSINGS.

Specification and form of Tender (on which alone offers will be considered) and drawing can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of Two Shillings and Sixpence.

Tenders should be forwarded so as to reach the undersigned not later than 5 p.m. on Saturday, 25th June, 1927, in the envelope provided for the purpose.

The Directors do not bind themselves to accept the lowest or any Tender.

C. E. RILEY, Secretary.

Kingsbridge Station, Dublin, June, 1927. 5707

PUBLIC NOTICES

City of Winchester. MAIN DRAINAGE. CONTRACT NO. 4. TO CONTRACTORS.

The Corporation of Winchester are prepared to receive TENDERS for the CONSTRUCTION of a SEWAGE STORAGE TANK, a LOW-LEVEL PUMPING STATION, a DETRITUS TANK and SCREEN CHAMBER, a STORM WATER PUMPING STATION, the LAYING and JOINTING of sundry PIPE LINES and other WORKS at their Sewage Pumping Station, which is about two miles from Winchester Station on the Southampton and Bournemouth Main Line (Southern Railway) and about one mile from Winchester Goods Station (Great Western Railway), all in accordance with the plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Copies of the specification, bill of quantities and form of Tender may be obtained from and the drawings may be seen at the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Winchester Drainage, Contract No. 4," addressed to the undersigned at the Guildhall, Winchester, must be received before Noon on Monday, the 27th day of June, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order, (Sgd.) THOMAS HOLT, Town Clerk.

The Guildhall, Winchester. 5717

Medway Union, Chatham. TO HEATING ENGINEERS.

The Guardians of the Poor of the Medway Union, Magpie Hall-road, Chatham, Kent, invite TENDERS for the SUPPLY and ERECTION of NEW HEATING, HOT WATER SUPPLY, STEAM and other PLANT at their Poor Law Institution and Hospital at Chatham, Kent. Tenders must include for the whole of the work specified. Plans, specifications and schedules of quantities may be seen on application to the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., of 17, Victoria-street, Westminster, S.W. 1, between the hours of Ten and Four (Saturdays excepted).

Copies of the plans and specifications can be obtained ONLY FROM ME on payment of Two Guineas (which will be returned on receipt of a bona fide Tender). Sealed Tenders, endorsed "Heating and other Plant, Medway Union," to be delivered to me not later than 10 a.m. on Monday, 4th July, 1927.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order, PERCIVAL C. LACY, Clerk to the Guardians.

Clerk's Offices, Medway Poor Law Institution, Magpie Hall-road, Chatham, Kent. 5743

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. COPPER INGOTS.
2. COPPER TUBES.
3. SPRING STEEL.
4. METALS.
5. LEATHER BELTING, HIDES, &c.
6. PIG IRON.
7. FIREBRICKS AND CLAY.
8. BEST YORKSHIRE IRON.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked :—"Tender for Copper Ingots," or as case may be, must be left with the undersigned not later than 12 Noon on Friday, the 1st July, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, of 5s. for each copy of Specifications Nos. 2, 3, 4, 5 and 6, and of 2s. 6d. for each copy of Specifications Nos. 7 and 8.

A. MUIRHEAD, Managing Director.

91, Petty France, Westminster, S.W. 1, 15th June, 1927. 5748

RAILWAYS. WAGONS.

The Consulting Engineers to the Gackwar's Baroda State Railways (Messrs. RENDEL, PALMER and TRITTON, 12-14, Dartmouth-street, Westminster, S.W. 1) invite TENDERS for FIFTY METRE-GAUGE 4-WHEELED COVERED GOODS WAGONS.

Specification and Tender form can be obtained from their office on payment of £1 (which will not be returned). 5696

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PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF STORES, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the under-mentioned STORES, &c., for the periods of six and twelve months commencing 1st August, 1927 :—

Tender No.
2 .. BRUSHES and BROOMS.
5 .. COTTON WASTE, &c.
6 .. HEMP ROPE, YARN, &c.
10 .. LEAD, BRASS, &c.
13 .. OILMAN'S SUNDRIES.
14 .. PACKINGS, BELTING, &c.
15 .. PAINTS, &c.
18 .. SCRAP IRON (DISPOSAL OF).
24 .. ELECTRIC LAMPS.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Thursday, 9th June, 1927, by personal application at the Board's offices (Room 156), or upon forwarding a stamped addressed brief envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Thursday, 23rd June, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
4th June, 1927. 5680

Metropolitan Water Board.

VENTURI METERS FOR KEMPTON PARK NEW WORKS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of THREE VENTURI METERS complete with RECORDING APPARATUS, &c., and a SUPPLY of DIAGRAMS, together with the FIXING of the RECORDERS and PRESSURE PIPES, as described in the specification and as shown on drawing No. 1927-13/39. The Venturi tubes will be fixed by the Board under the supervision of the contractor. The meters and accessory parts are to be delivered to the Board's Kempton Park Pumping Station, Hanworth-road, Sunbury Common, Middlesex, free of any charge to the Board and at the risk of the contractor, in accordance with the conditions of contract. The meters are to be of the following sizes :—

One 48in. diameter, max. flow 30 million gallons per day, min. flow 5 million gallons per day.
One 42in. diameter, max. flow 24 million gallons per day, min. flow 5 million gallons per day.
One 30in. diameter, max. flow 12 million gallons per day, min. flow 3 million gallons per day.

Tenderers must submit detailed drawings of the tubes and recording apparatus, together with a full description thereof, and must submit samples of diagrams proposed to be supplied.

Tenders must be submitted on the official forms containing full specification and conditions of contract, which may be obtained from the Chief Engineer on and after Saturday, 18th June, 1927, by personal application at the Board's offices (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Venturi Meters," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 29th June, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
11th June, 1927. 5714

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Ltd., 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) 13 THROUGH SPANS of 136ft. CENTRES of BEARINGS (Approx. Total Weight equals 1846 Tons).
(2) 92 PAIRS WHEELS and AXLES for CARRIAGES and WAGONS (with DISC CENTRES and SANDBERG SORBITIC TYRES).

Tenders are due in as follows :—
No. (1) by 10.30 a.m. on Monday, 4th July, 1927.
No. (2) by 2 p.m. on Tuesday, 5th July, 1927.
Tender forms obtainable at above address ; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 5715

PUBLIC NOTICE.

Bombay Municipality.

APPLICATIONS are INVITED for the POST of the DEPUTY EXECUTIVE ENGINEER, DRAINAGE, on a salary of Rs. 1200-50-1500 per mensem, plus conveyance allowance in accordance with the rules of the Corporation.

The post is at present a supernumerary one, but the selected candidate will be confirmed in the post on the 1st April, 1928, or after such period of probation not exceeding 6 months in all, as may be considered necessary.

Applicants must have been regularly trained as Civil Engineers, particularly in Sanitary Engineering, and should have had preferably about 10 years' practical experience in Civil Engineering. They must have administrative ability and good and sound knowledge and experience in designing, estimating, supervising and maintaining large Drainage and Sewerage Works. They must be Corporate Members of the Institution of Civil Engineers (England) or the Institution of Engineers (India), or must hold the Testamur of the Institution of Municipal and County Engineers, or must be Graduates in Civil Engineering of any recognised European, American, or Indian University.

Applications, stating age, training and qualifications, with copies of not more than three testimonials and two references, should be addressed to the Municipal Commissioner for the City of Bombay, and should reach him not later than 31st August, 1927.

The successful candidate will be entitled to the benefit of the Leave Rules and Provident Fund Rules applicable to Municipal Servants for the time being in force.

Employees in Bombay municipal service are not debarred from applying for the post, but such applications should be made through the heads of their respective Departments.

H. B. CLAYTON,
Municipal Commissioner for the City of Bombay.
Municipal Offices, Bombay,
20th May, 1927. 5683

County Antrim County Council.

APPLICATIONS are INVITED from qualified Engineers with experience of Harbour Work (Reinforced Concrete Piling, &c.) for the POST of CLERK OF WORKS in connection with the proposed Repair of Church Bay Pier, Rathlin Island.

Engagement would be for about 4 months.

Applications, stating age, experience and salary required, and accompanied by not more than three recent references, to be sent to the COUNTY SURVEYOR, County Courthouse, Belfast, before 25th June, 1927.

Appointment will be subject to approval of the Ministry of Commerce (N.I.). 5695

Sudan Government, Public Works

DEPARTMENT. REQUIRE the SERVICES of TWO CIVIL ENGINEERS. Age 25 to 32, preferably single. Candidates should have had thorough civil engineering training and possess A.M.I.C.E. degree or equivalent. Design of structural steel work, &c., an added qualification. Commencing salary £E480-540-600 per annum, according to age and qualifications (£E1 equals £1 0s. 6d.) ; 18 months' contract. Free first-class passage out and home. Progressive post if satisfactory. Strict medical examination.—Apply by letter, giving details of education, training and experience, to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "Civil Engineer." 5718

PUBLIC NOTICES

Local Appointments Commission

POSITION VACANT—BOROUGH SURVEYOR.

The Local Appointments Commissioners invite APPLICATIONS for the POST of BOROUGH SURVEYOR of the County Borough of Waterford. The post is whole time, permanent and pensionable. Salary £500, rising by annual increments of £25 to £750 per annum, inclusive. Age limits 25 to 45 years on 1st June, 1927, with an extension of the maximum limit in favour of a Borough Surveyor or County Surveyor or Town Surveyor of an important Urban District.

Candidates must hold a degree in Civil Engineering from a recognised University or some equivalent or higher professional qualifications, and must have been regularly trained as Civil Engineers, be engaged in the practice of their profession and have for a period of not less than four years had charge of important works in the course of their practice. Importance will be attached to special qualifications and practical experience in Electricity Supply and Distribution.

The appointment will be made by the Waterford County Borough Council on the recommendation of the Local Appointments Commissioners. Preference will be given to qualified candidates with a knowledge of Irish. Canvassing in any form will automatically disqualify.

Latest date for receiving applications, which must be on the prescribed form, is 30th June, 1927. Copies of the form and further particulars may be obtained from the SECRETARY, Local Appointments Commission, 33, St. Stephen's Green, Dublin.

4/8.392. W. H. Co. 5722

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Keen, Able OUTSIDE ORGANISER of New Staff. Must be successful traveller with best credentials, willing to help carry through financial revision and reconstruction of company, to join capable educated expert in allied business to engineering. Fine opportunity.—Address, P3311, The Engineer Office. P3311 A

WANTED, WORKS MANAGER for Large Iron and Steel Works. Must be capable organiser and have complete knowledge of Engineering and Manufacture.—Address, with full particulars of experience, age, and salary desired, P3293, The Engineer Office. P3293 A

ELECTRICIAN REQUIRED, with Sound Technical training and first-class knowledge of Heating by Electricity ; must have initiative. State fully training, experience, age, salary, references.—Address, 5725, The Engineer Office. 5725 A

ESTIMATING ENGINEER for Air Cleaning, Ventilating, Heating and Dust Removal Plants by London Engineering Firm.—Address, with full particulars, experience, salary required, 5711, The Engineer Office. 5711 A

HEATING ENGINEER WANTED, to Obtain and Follow Up Enquiries in the Midlands. Must be a technical man with drawing-office experience. State age, experience, where educated, and salary required.—Address, 5724, The Engineer Office. 5724 A

OUTDOOR SALES ENGINEER for London. Preferably with experience in Air Heating, Cleaning and Dust Collecting Plant, and knowledge of the district. Send application with experience, training, salary required.—Address, 5710, The Engineer Office. 5710 A

PLANNER and RATE-FIXER WANTED by Internal Combustion Engineers in the Midlands, accustomed to working from drawings. State age, experience, salary required, with references.—Address, 5723, The Engineer Office. 5723 A

RATE-FIXER WANTED for Mass Production Engineers near London. Automatic and Grinding experience essential.—Address, 5727, The Engineer Office. 5727 A

TRAVELLER REQUIRED, Structural Engineers, London district ; some drawing-office experience. State age and salary required.—Address, 5712, The Engineer Office. 5712 A

WORKS MANAGER and PRODUCTION ENGINEER REQUIRED for Motor Works. Applicants must be competent and have had practical experience in America. To a man possessing ability an excellent opportunity is open at a liberal and progressive salary. State fully age, experience, and salary required. Copies only of testimonials.—Write, R., c/o 6, Bloomsbury-street, W.C. P3248 A

WANTED, a LOCOMOTIVE DRAUGHTSMAN. State age, experience, and salary required.—Apply, W. G. BAGNALL, Ltd., Castle Engine Works, Stafford. 5720 A

WANTED, a Thoroughly Experienced OIL ENGINE DRAUGHTSMAN, capable of designing engines, also with experience in drawing-office organisation.—Address, stating age, experience, and salary required, 5713, The Engineer Office. 5713 A

WANTED, for the North-East Coast, TWO DRAUGHTSMEN for Oil Engine Detail Development Work. Thorough knowledge of Oil Engines essential.—Address applications, stating experience and salary required, 5703, The Engineer Office. 5703 A

WANTED IMMEDIATELY, Competent DRAUGHTSMAN, with experience in Blast-furnace and Steel Works.—Address, stating age, experience and salary required, 5708, The Engineer Office. 5708 A

WANTED, JIG AND TOOL DRAUGHTSMAN. First-class men only need apply. State age, experience, and wages required. Bristol District.—Address, P3326, The Engineer Office. P3326 A

CAM DESIGNER for Automatics with B. and S. experience.—Full particulars to WORKS MANAGER, Davis and Timmins, Ltd., Brock-road, Wood Green, N. 22. P3316 A

DRAUGHTSMAN, Fully Qualified, Experienced in Factory Lay-out, REQUIRED in provincial town.—Address, 5742, The Engineer Office. 5742 A

DRAUGHTSMAN REQUIRED. Must Have Had first-class experience in the Design and Construction of Horizontal and Vertical Heavy Oil Engines. Age about 35 years.—Address, giving full particulars and salary required, 5741, The Engineer Office. 5741 A

FIRST-CLASS DRAUGHTSMAN WANTED for Tender Designs of Heavy Steam Breakdown Cranes.—Apply, stating age, experience and salary required, to "DRAUGHTSMAN," Messrs. Ransomes and Rapier, Ltd., 32, Victoria-street, London, S.W. 1. 5746 A

GOOD DETAILING DRAUGHTSMAN WANTED for prompt engagement. Only one used to Steel Frame Buildings (1909) Act need apply. Please state age, experience, salary expected, and when free to commence.—Address, P3308, The Engineer Office. P3308 A

JUNIOR DRAUGHTSMAN REQUIRED in Engineering Contractor's Westminster Offices, with knowledge of General Engineering and Perspective Drawing. Capable compiling statistical tables and charts.—Address, 5709, The Engineer Office. 5709 A

STRUCTURAL DRAUGHTSMAN (Junior) WANTED. —State age, experience, and salary required, to Box No. 668, W. S. Crawford, Ltd., 233, High Holborn, W.C. 1. 5699 A

SITUATIONS OPEN (continued)

EXPERIENCED FOREMAN WANTED, Capable of taking entire control of Light Machine and Fitting Shop with Tool-room ; must be a good organiser, capable of producing highest class work at low cost, good disciplinarian and timekeeper. Only first-class men used to modern methods of production need apply, stating age, experience, and salary.—Address 5705, The Engineer Office. 5705 A

SITUATIONS WANTED

ENGINEER (32), B.Sc., Dipl. B.T.C., A.M.I. Mech. E., experienced in high-speed turbine design fans and air preheaters, WISHES POSITION, preferably with firm of consulting engineers.—Address, P3314, The Engineer Office. P3314 B

ENGINEER of Exceptionally Wide Experience, used to full control of commercial, drawing-office and works staffs, DESIRES POSITION as GENERAL MANAGER works, 1000/5000 men. Highest references. Administrative and production efficiency. Would accept part remuneration on results.—Address, P3292, The Engineer Office. P3292 B

ENGINEER (47, Single), A.M.I. Mech. E., Extra Chief B.O.T. Certificate, wide experience surveying and management of factory and marine plant, steam and electrical, used to control of men, several years' commercial and office experience, SEEKS SITUATION, any capacity, home or abroad.—Address, P3310, The Engineer Office. P3310 B

ENGINEER (30), Well-educated, Apprenticeship and college (eng.) training, works staff and travelling experience, DESIRES to GET IN TOUCH with FIRMS which could use his services. Enterprising, strict integrity ; ex-Service.—Address, P3321, The Engineer Office. P3321 B

EXPERIENCED ENGINEER SALESMAN (28), WISHES to HEAR from MANUFACTURERS desirous of EXTENDING their BUSINESS in London area. Salary, expenses and commission, or commission only.—Address, P3323, The Engineer Office. P3323 B

HONS. B.Sc. (23), Two Years on Outside Work with public works contractors only, DESIRES POSITION, preferably in drawing-office of Structural Engineers or similar.—Address, P3309, The Engineer Office. P3309 B

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PATENTS

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No. 196,933 (A. Thomas and Co.), "Improvements in Carburettors for Explosion or Internal Combustion Engines ;"
No. 218,705 (H. A. Puttemans and G. Perpete), "Improvements in or relating to Adding Machines ;"
No. 218,981 (idem.), "Improvements in Adding and Printing Machines ;"
No. 200,337 (Ch. Torley), "Improved Filtering Material for Water and other Liquids and Process for Preparing said Material ;"
No. 158,568 (P. Surdiacourt) "Improvements in and relating to Heating Stoves ;"
No. 211,502, with Addition 220,947 (R. Navet), "Improvements in and relating to Pistons of Presses for the Manufacture of Bricks and Similar Articles ;"
No. 211,503 (R. Navet), "Improvements in and relating to Presses for the Manufacture of Bricks, Tiles, and the like ;"
No. 211,504 (R. Navet), "Improvements in and relating to Presses for the Manufacture of Bricks, Tiles, Slabs, and Similar Products ;"
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No. 178,969 (R. Kern), "Improvements in and relating to Wire Brushes ;"
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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

A Year's Explosions.

THE fifty-first annual report of his Majesty's Inspectors of Explosives shows that during 1926 the total number of accidents reported to the Inspectors was 276, and that these accidents involved 36 deaths and 269 cases of injury. These figures are in each instance less than the corresponding averages for the past eight years, and also for the averages of the eight years 1906 to 1913, a fact attributable to the prolonged stoppage of the coal mines. It is significant that while 55 accidents in the manufacture, keeping, and conveyance of explosives led to but two deaths and injuries to 15 people, the 220 accidents in the use of explosives caused 34 deaths and 254 cases of injury. The disproportionate number of casualties to accidents in the use of explosives as compared with the manufacture, &c., of explosives suggests—and the Inspectors from their own investigations stress this point—that the mishaps with explosives in mines and quarries are avoidably high. An examination of the details of the accidents arising from the use of explosives shows that of the 34 fatalities recorded 14 occurred in coal mines and 12 in quarries. The commonest and most fatal cause of these accidents in use was failure to take proper cover. Returning too soon to the shot hole and tampering with misfired shots taken together came second. Two accidents classified as caused by fumes occurred in connection with the use of liquid oxygen as an explosive. Both these mishaps took place during work for the Lochaber water power scheme. Neither proved fatal, but together they caused 16 cases of injury. Explosions from petroleum came during the year fully within the scope of the Inspectors' work. Under this heading they report 12 accidents involving 4 deaths and 20 cases of injury. The Inspectors in their report advance practical evidence in disproof of the common belief that petrol vapour cannot be lit by a burning cigarette. They also give an instance which supports the view that water, if in the form of a fine mist as produced by sprinkler apparatus, is, contrary to a common contention, an effective means of extinguishing a petroleum spirit fire.

A Safe Aircraft Competition.

FULL particulars are now available of the Safe-Aircraft Competition which has been instituted by the Daniel Guggenheim Fund for the Promotion of Aeronautics. The prizes offered are one of 100,000 dollars and five of 10,000 dollars each. Entries for the competition will be received on and after September 1st, 1927. The competition will be held in a field near New York and will be completed on or before October 31st, 1929. In addition to certain qualifying requirements designed, we infer, to exclude from the competition machines the entry of which would merely waste time and money, the rules specify various safety tests and demonstrations which the aeroplanes entered will have to attempt and on which the marks determining the winners will be awarded. These safety requirements bear the stamp of sound and prolonged consideration by experts. They set a high standard, but should not be beyond the reach of development of current design. The machines, for example, are to be capable of maintaining level and controlled flight at a speed not exceeding 35 miles an hour and to have a maximum gliding speed with all power shut off of 38 miles an hour. They are to be capable of coming to rest within 100ft. from the point at which they first touch the ground and shall land and take off over an obstruction 35ft. high with a run of not more than 300ft. from the base of the obstruction. Stability tests, tests of ability to recover from abnormal conditions, tests of controllability and tests of manœuvrability in restricted territory and on the ground will also be applied. Full particulars of the competition may be found in the June issue of the *Journal* of the Royal Aeronautical Society.

The Geneva Naval Conference.

THE opening session of the Naval Limitation Conference initiated by the United States Government will be held at Geneva on Monday next, June 20th. Originally intended to embrace the five Powers which took part in the first Naval Conference at Washington in 1921–22, the present gathering has been reduced to the three-Power basis, owing to the refusal of France and Italy to attend. The proceedings will therefore be confined to the British Empire, the United States, and Japan. This circumstance deprives the Conference of part of the importance it would otherwise have had, but the promoters are, nevertheless, hopeful that some further progress will be achieved in the limitation of naval armaments. The British Empire delegation is headed by the First Lord of the Admiralty, Mr. F. C. Bridgeman, and includes, among others, Lord Cecil of Chelwood, and Vice-Admiral Sir Frederick L. Field, Deputy Chief of the Naval Staff. Admiral of the Fleet Earl Jellicoe will be one of the two representatives of the Dominion of New Zealand. Mr. Hugh Gibson, the American Minister to Belgium, is chairman of the United States delegation, whose naval experts include Rear-Admiral Hilary Jones, Chairman of the General Board of the Navy, and six other naval officers. Japan's principal delegate is Viscount Saito, a former Minister of the Navy, among whose naval advisers are Vice-Admiral Kobayashi, a former naval attaché in London; Rear-Admiral K. Hara, and Captain T. Toyoda, who was recently relieved as naval attaché to this country. The agenda is understood to include proposals for a drastic reduction in the Washington Treaty standards of warship tonnage, and for a solution of certain technical problems arising out of the Treaty.

The Mechanised Army.

THE composition and equipment of a mechanised infantry battalion have now, it is stated, been settled by the Army Council. The battalion will have a total strength of 728 of all ranks, the same, that is to say, as the existing peace establishment of an ordinary line regiment. It will be divided into four companies, of which one, with a strength of 213, will be armed with rifles, the remaining three with a total strength of 515 being equipped with machine guns. The mechanical equipment will consist of 36 machine guns, 10 Lewis guns, 14 light cars, 4 light six-wheeled lorries, 32 30-cwt. half-track lorries, 4 water carts with kitchen trailers, and 5 motor cycles, one with a side car. It may be recalled that, as officially announced at the beginning of May, the experimental force of completely mechanised units now being assembled at Tidworth under the command of Colonel R. J. Collins is to consist of an infantry battalion re-equipped as a machine gun unit, together with a tank battalion, an armoured car company, a field brigade of Royal Artillery, a pack battalion of Royal Artillery, a field company of Royal Engineers, and a signal unit.

Armstrong's and Vickers'.

AT the annual meeting of Sir W. G. Armstrong, Whitworth and Co., Ltd., held in Newcastle last week, Mr. J. F. Taylor, presiding in the absence of Lord Southborough, stated that among the possibilities of the future were closer working arrangements between the firm and Vickers Ltd. Conversations, he said, were taking place and should anything of moment develop news of it would be laid in due course before the shareholders. It was possible that in such arrangements the two firms would find material benefit. Mr. Taylor also intimated that the firm had disposed of its investments to good advantage in the Armstrong Siddeley Companies and Messrs. Walmsleys, of Bury. Dealing with the Newfoundland Power and Paper Company, Ltd., in which Messrs. Armstrong were interested to the extent of £2,914,421, Mr. Taylor stated that with their assent the Newfoundland Company had entered into negotiations with the International Paper Company, of New York, which, if carried to the intended arrangement, would result in the American company assuming responsibility for the further finance of the Newfoundland business. Messrs. Armstrong would then obtain relief from their guarantees, but would have to forgo the whole of their remaining investment in the Newfoundland company. Another considerable loss, he remarked, would have to be faced in connection with the voluntary liquidation of the Italian company, the S. A. Armstrong di Pozzuoli, in which Messrs. Armstrong had invested £1,400,000. The firm's investments in the Pearson and Knowles group of companies amounting to £1,608,500 were also a source of anxiety. The time was approaching, he said, when the directors would be able to consider the revaluation of the whole of Messrs. Armstrong's investments and properties and the reconstruction of the balance sheet. The writing down of capital would be considerable, but the full extent was not yet known.

A French Railway Centenary.

LAST Sunday, June 12th, the town of Saint-Etienne celebrated the centenary of the first railway established in France. It was not a railway in the strict sense of the word, being merely a line of cast iron rails between Saint-Etienne and Andrézieux for conveying coal to the Loire by horse traction, exactly in the same way as was being done at some English collieries. The construction of the line was started early in 1826, and was finished a year later. Its total length was about 12¼ miles. The success of the line was so great that the brothers Séguin were enabled to carry through a scheme for constructing a railway between Saint-Etienne and Lyons, for which they obtained a concession in March, 1827. Marc Séguin took upon himself the task of providing the rolling stock. His name is associated more particularly with the invention of the multi-tubular boiler. He is also credited with being the first to substitute rolled iron rails for the cast iron rails employed in England and he used wood sleepers. The first section of the line between Rive-de-Gier and Givors was opened to traffic in 1830, principally for the transport of coal. The trucks were hauled by horses or by locomotives. Two years later the whole line was completed. Horses continued to be employed to a large extent, and it was not until 1844 that they were finally superseded. As the birth-place of the railway in France, Saint-Etienne has acquired particular importance, and at the celebration on Sunday a memorial tablet to Marc Séguin was unveiled. The next railway celebration in France will be ten years hence, and will mark the centenary of the inauguration of the Paris–Saint-Germain line. On that occasion a monument will be erected in Paris, in the Place Pereire, in memory of Emile Pereire, whose enthusiastic persistence alone made possible the construction of what was really the first passenger railway in France.

The Turbinia.

THE Turbinia, Sir Charles Parsons' famous experimental vessel, has, it is announced, been presented to the nation. This vessel was completed in 1897, and had a length of 100ft., a beam of 9ft., and a draught of 3ft. Her main propelling machinery, as finally fitted, consisted of a high and an intermediate-pressure turbine on the starboard and port shafts respectively, and a low-pressure and a separate reverse turbine on the centre shaft. The main propelling machinery developed 2000 S.H.P., and gave the vessel a speed of 34½ knots. For some years past the Turbinia has been lying shored up at Parsons' Quay, Wallsend. She was offered entire to the Science Museum at South Kensington, but, unfortunately, the accommodation available will not be sufficient to permit her to be shown whole. She has been cut in two, and the after part containing the turbine machinery is alone being sent to the Museum. The first turbine engine fitted on the Turbinia, a single turbine driving one shaft, has also been presented to the Science Museum. An earlier turbine built by Sir Charles Parsons in 1884 and successfully applied to the driving of a dynamo is already at South Kensington.

Salvage Operations at Scapa Flow.

WE are pleased to record that progress has been made by Cox and Danks, Ltd., in the salving of the ex-German battle-cruiser Moltke at Scapa Flow. The ship was sunk in a completely upturned position off the island of Cava, and originally she had a list of 16½ degrees. By closing all apertures on the underside of the hull and admitting compressed air, the hull was rendered partially buoyant, but up to the end of last week further operations were delayed by the prominent list, which remained at about 12 deg. This list was gradually reduced to between 2½ deg. and 3 deg. by the use of wire ropes attached to the firm's large floating docks and by the careful trimming of the vessel, and on Thursday of last week the stern end of the ship was raised to the surface and the propellers brought to view. Some six air compressors were employed continuously, and over the week-end the fore part of the vessel was also lifted sufficiently to allow the towing operation to be begun. By Monday evening, June 13th, the Moltke had been towed nearly a quarter of a mile towards the island of Cava, on the shore of which it is intended to beach the vessel before breaking up the hull and removing her machinery through openings in the bottom. At first the towing operations were retarded by parts of the gun equipment fouling the sea bottom, but after inspection by divers it was found possible to free the ship and to continue the towing.

Wages in the Engineering Trades.

ON Tuesday morning, June 14th, a conference took place in London between the Engineering and Allied Employers' National Federation and the representatives of over thirty unions associated with the engineering industry, to negotiate further on the application for an advance of wages. Mr. J. T. Brownlie, who stated the case for the unions, endeavoured to obtain a further concession from the employers by asking them to withdraw the condition attached to their offer of May 19th with regard to a revision of the overtime and nightshift rates, if a 2s. 6d. advance to all grades was made. After a long and careful consideration of the position, Sir Allan Smith, representing the owners, stated that the present state of trade did not enable them to improve on the offers already made. The representatives of the men, meeting separately, decided that they would not put forward the employers offer of 2s. 6d. increase with a revision of the overtime and nightshift rates, but that they would submit to a ballot vote the alternative offer of an increase of 2s. to the war bonus of plain time workers, but without a recommendation for acceptance. Arrangements are to be made to take a ballot vote immediately, and if the proposed advance is accepted, it will take effect on the first pay day in August. The plain time workers represent about 51·2 per cent. of those employed in the industry. In commenting on the result of the negotiations, Mr. Brownlie stated that he hoped that at the end of six months there would be such a revival in industry that the employers would welcome the opportunity of giving to the men the wage increase they were entitled to receive.

A New Hydraulic Formula.

By F. W. WOODS, C.I.E.

PROBLEMS connected with the flow of silt-bearing streams of water in channels of friable soil are still the subject of uncertain speculation to an extent that is surprising in view of the opportunities that have long been available for precise investigations of the natural laws applicable to the same.

In India, particularly, for more than fifty years past, there have been in existence vast systems of perennially-flowing irrigation canals, comprising channels of all magnitudes, ranging in discharge from one cusec up to 12,000 cusecs; and although problems of silting and of scouring, involving expenditure or economy, financial profit or financial loss, have been ever present to the engineers in charge of the works, the advance accomplished in knowledge of the subject has been disappointingly small.

In Europe, where many canals, as well as rivers, have been open to scientific observation for centuries past, very little scientific research has been applied to the problems here referred to. In the seventeenth century Mariotte (1620–1684) showed experimentally that the velocities of a flowing stream decrease, from the surface and centre towards the bed and sides, and he ascribed the retardation of flow to friction between the water and the solid surface of the channel. In the eighteenth century Pitot (1695–1771) invented his well-known hydrometric tube, and showed that, in flow through pipes, the retardations arising from friction are inversely proportional to the diameters of the pipes.

DU BUAT'S THEORY.

The Chevalier Du Buat (1734–1809) was the first to use the expression *vitesse de régime* (régime velocity) to denote the velocity of a current so equable that it neither scours, nor deposits sediments on, the bed or sides of its channel. Unfortunately, he deduced from experimental observations a hypothesis of flow which has, through fallacious plausibility, set up much confusion, in the discussion of silt carriage and silt deposit by currents of water, ever since. This theory was: "The molecules of water introduce themselves into the pores of the channel soffit, and fill up all the little cavities of that surface. Moreover, they themselves form a surface over which the rest of the water has to flow; whence it follows that differences in the material of which the soffit is composed make no appreciable difference to the intensity of resistance to flow. The wetted surface of a channel is an assemblage of globules, over which the mobile particles of the current glide."

DARCY'S EXPERIMENTS.

Darcy, in 1855–58, showed by experiments on the flow through pipes that Du Buat was wrong in supposing that differing degrees of rugosity in the material of the pipe did not exercise different degrees of retardation on the flow. This demonstration should have demolished, simultaneously, Du Buat's theory of "slip" between liquid and solid, and of measurable "bottom velocity"; but these popular fallacies have unfortunately exhibited a remarkably pernicious vitality, down to date.

DUPUIT'S THEORY.

In 1863 Dupuit, in his treatise, "Etudes Theoriques et Pratiques," showed that if sand or gravel be placed in a vase with water, and the vase be caused to rotate, the heavier bodies are carried up in the water, in proportion as the velocity is augmented. He deduced the theory: "The difference of velocity of the filaments, in making unequal currents pass to right and left of the solid body, engenders a force which pushes it to the side of the faster fillets. . . . If we imagine a solid body plunged into the current, we would recognise that the relative velocity of the filaments, in the vertical direction, will engender a pressure which will carry it to the side of the faster, *i.e.*, it will act from below to above."

LOGIN'S THEORY.

In 1867 Login, one of the engineers of the great Ganges Canal, in India, in a paper read to the Institution of Civil Engineers, expressed opinions to this effect: "The author believes that the power of water to hold matter in suspension is directly as the velocity, and inversely as the depth. It is also suggested that water in motion rolls, rather than slides; and that it is owing to this rotary motion that water has the power to hold matter in suspension. Further, that with given velocities and defined depths, only a certain quantity of matter can be held in suspension, whatever may be the character of the bed and banks of the canal or river. If velocity be increased and the depth remains constant, scour will take place. If velocity be decreased and depth is the same, there will be deposit."

Login's theories met with a large measure of acceptance, and came to be known outside India as the "Indian theory." He did not, however, present any data of experimental observation in support of them.

HARRIS' EXPERIMENTS.

In December, 1892, F. Harris, B.A. (Oxon), a Punjab irrigation engineer, in articles published in the Calcutta journal, *Indian Engineering*, discussed the results of observations made by himself, in 1890, of the flow in seven *rajbahas*, or distributaries, of the Bari Doab Canal system, ranging from 50 to 250 cusecs in discharge. He essayed to determine the quantity of silt deposited in each of these channels during a given period, and to establish a relationship between that and the value of Kutter's coefficient N of retardation prevailing in each channel. Unfortunately, his method of determining the amount of silt deposit was unsound; and, as he omitted to tabulate his data of observation, such as width and depth of stream, surface slope, mean velocity, &c., or even to identify the channels dealt with, his investigations lacked the utility they might otherwise have had.

He inferred that it is neither the surface fall, nor the mean velocity, that determines silt-carrying capacity, but rather the ratio of width to depth of water, and that this silt-carrying power, in the channels dealt with, was greatest when the ratio of width to depth was about 5. Owing to the defects of his *modus operandi*, however, the only conclusions definitely established by his records are:—

(1) That in five out of the seven channels the value of Kutter's (N) lay between 0·025 and 0·027, whilst in a sixth it was 0·024.

(2) That the ratio of width to depth in those seven cases ranged between 3·6 and 7·1, with average 5·8.

(3) That the ratio of width to depth influences silt-carrying capacity.

KENNEDY'S FORMULA.

In 1890 R. G. Kennedy assumed charge of the same parts of the Bari Doab Canal as had just previously been controlled by Harris, and he carried on investigations of the silt problem. In 1894–95 he presented to the Institution of Civil Engineers a paper on "The Prevention of Silting in Irrigation Canals"—Vol. CXIX., Inst. C.E.—wherein he tabulated the hydraulic data of twenty-eight sites on the Bari Doab Canal system and of two on the Katora Canal, whose discharging capacity ranged between 26 and 1700 cusecs, and deduced therefrom the conclusion that the requisites of a "*régime* channel," free from troubles either of erosion or of silting, were fulfilled when the relation between mean velocity and water depth was represented by the equation $V_o = c\,d^m = 0{\cdot}84\,d^{0{\cdot}64}$. This V_o he described as the "critical" mean velocity of the border line between silt and scour. In contradiction of Harris' contrary opinion, Kennedy inferred from his own observations that "apparently the bed width has no place in the equation connecting the depth d and the mean velocity V_c."

The Bari Doab Canal offtakes from the river Ravi only a few miles below the exit of the river from the Himalaya Mountains, and where the bed of the river is composed of boulders and shingle. Kennedy's observations were made at sites on the canal system ranging from 50 to 130 miles distant from canal head. He expressed opinion that "in these lower reaches of the canal the amount of silt carried for any given discharge was more or less constant all the year round, though it was by no means so at canal head. The channels of the Bari Doab Canal system have assumed permanent sections by silting or scouring, and all the sites discussed had silted beds, often 2ft. or 3ft. deep, deposited during many years of steady flow. No silt was ever cleared away from these reaches, and therefore for a considerable time the silt-transporting power in each has been just sufficient to carry all the sediment brought down, and each reach could have carried neither more nor less than this amount, under the given conditions of width of bed, depth of channel, and velocity of flow. It has been invariably found that the form of the cross section thus arrived at is nearly rectangular, the sides being vertical and of fine sediment, and the bed horizontal and of coarser sand."

The state of affairs thus described by Kennedy was the same as had been visualised in the theories of Login twenty-five years before. In an anonymous article, published in *Indian Engineering* in August, 1895, Harris disputed the correctness of Kennedy's description of existing hydraulic conditions, viz.:—

(1) That the channels discussed had arrived at a condition of permanent silt equilibrium or *régime*; and

(2) That the amount of silt per cubic foot of water was constant at one instant throughout the whole system.

Strangely enough, however, Harris acquiesced in Kennedy's conclusion that the ratio of width to depth of stream had no influence upon the silt-carrying capacity; though he might easily have proved, had he looked into the matter, that, from Kennedy's own data, the influence in question was indisputable.

In 1896 Sir Thomas Higham, Chief Engineer, Irrigation Works, Punjab, discussed, in Technical Paper No. 7, with a certain measure of approval, Kennedy's formula and Harris' investigations. Higham recognised that the adoption of that formula would lead to the designing of canals relatively much wider and shallower than had been, up to that time, the usual practice, and he calculated that the canal of maximum efficiency, *i.e.*, maximum velocity and minimum loss by absorption, would be, in the case of "small channels"—whatever that might imply—one with bed-width double the depth.

LATER EXPERIMENTS.

In 1897 the writer made some experiments with a view to ascertaining the differences of hydraulic conditions between a silting and a non-silting channel. At that time treatises on hydraulics generally accepted as authoritative Du Buat's conclusions as to the "bottom velocity at which scour commences;" as to the maximum bottom velocities consistent with stability of stream bed in different soils, such as loam, sand, gravel, &c.; and as to the ratio supposed to subsist between bottom velocity, maximum velocity, and mean velocity of the whole stream.

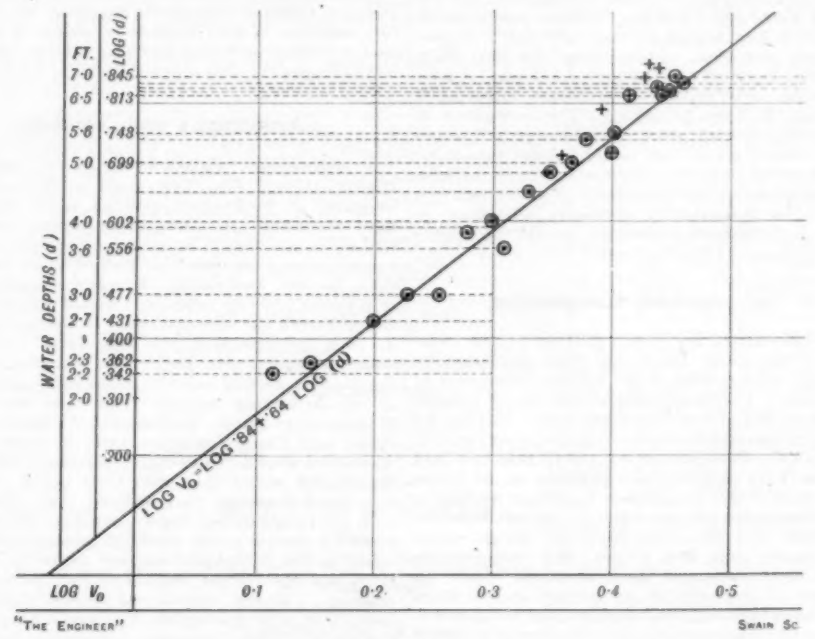


FIG. 1

The Gudha Minor Rajbaha of the Western Jumna Canal had been constructed with bed-width 3ft., water depth 3ft., side slopes 1 to 1, and longitudinal slope 1 in 5000, to discharge about 16 cusecs; but it was unable to maintain those dimensions. It used to reduce its water-depth by silt-deposit to 1·5ft., and its discharge to 8 cusecs, whilst increasing its longitudinal slope—on silted bed—to 1 in 2750. Whilst in this shallow condition its surface, bottom, and mean velocities were measured. The silt deposit was then cleared out by excavation, increasing its water depth to 3ft., and all velocities were again measured. It was found that the bottom velocity—really the velocity at elevation 3in. above bed—was practically the same in the deep, as in the shallow, channel. The mean velocity and the maximum surface velocity were somewhat greater in the deep than in the shallow channel, yet the deep stream was known to have less silt-carrying power than the shallow one. The only circumstance capable of explaining the difference of silt-carrying power in the two cases was, that the ratio borne, by the difference between surface and bottom velocities, to the water-depth $\left(\frac{v_s - v_b}{d}\right)$ was much greater in the shallow channel than in the deepened one. This meant that the difference of velocity, of two filaments of current a unit distance

apart in the vertical plane, was greater in the shallow than in the deep channel, a fact which, according to Dupuit's theory, explained the greater silt-carrying power of the shallower stream. This inference was presented to Higham and to Kennedy and accepted by them; and Higham remarked that it followed, from Dupuit's theory, that the erosive power implied by the horizontal eddies affected the width as well as the depth of a "*régime*" channel.

In the year 1903 the writer collected, from hydraulic surveys, the dimensional data of 186 different sites on channels of the Lower Chenab Canal system. These sites were from 80 to 130 miles downstream of main canal head, which head, again, was about 50 miles downstream of the exit of the river Chenab from the Himalayas. The channels dealt with were mostly of less than 300 cusecs discharge, though a few were between 300 and 1200 cusecs. The conditions of *régime* at which they had arrived after five years of flow were to a considerable extent corroborative of Kennedy's formula. They indicated, however, that mean velocity and discharge varied with width of channel, as well as with water depth, and in the light of this evidence Kennedy, in 1904; recognised the necessity of specifying a rough-and-ready sliding scale of ratios of bed width to depth, increasing with increase of discharge. But he made no alteration in his formula to show the influence of width, as well as depth, on "*régime*" mean velocity.

Normal Data of Design.

In the year 1917 the writer found it necessary to simplify design by tabulating a specification of definite ratios of width to depth, varying with magnitude of discharge, for canals of all capacities up to 20,000 cusecs. Kennedy duly approved of this attempt at greater precision of design; but, from the *Technical Review*, 1925, a recent publication of the Punjab irrigation engineers, it is evident that the problem of designing "*régime* channels" in that country is regarded with as much perplexity as ever.

In these circumstances a set of revised formulæ, in supersession or improvement of Kennedy's V_o formula, is herewith presented, and a scrutiny of Kennedy's formula is made by way of preliminary explanation.

Kennedy's Empirical Data.

In his Technical Paper of 1894–95 Kennedy presented the hydraulic data of twenty-eight channels of the Bari Doab Canal system, and two of the Katora Inundation Canal. This number may be compressed into twenty-seven, as tabulated below.

Table I.

Ser./l No.	Selected channels.	Full supply in cusecs (D).	Bed width in feet (*b*).	Water depth for full supply (*d*).	Mean velocity for full supply (V).
	Canal:				
1	Above Ralliali Weir ..	1700	86	6·8	2·90
2	Above Thiriawal Weir ..	1700	85	7·0	2·86
3	Above Doburji Rajbaha	1700	84	6·9	2·91
4	Above Fatehgarh Weir	1500	80	6·6	2·83
5	Above Doda Weir ..	1250	68	6·7	2·75
6	2 m. above Bhuchar ..	1250	70	6·5	2·81
7	At Bhuchar, Jaman ..	940	66	5·6	2·55
8	Above Lulliani	700	61	5·0	2·33
9	Above Bhamba	650	48	5·5	2·40
10	Above Gandian	390	36	4·8	2·25
	Rajbaha:				
11	Bhuchar	220	22	4·5	2·15
12	Turkwind	142	18	3·9	1·99
13	Raewind	138	18	3·6	2·04
14	Amritsar	120	14	4·0	2·0
15	Chabhal	85	16	3·0	1·7
16	Gilpan	75	14	3·0	1·7
17	Doda	70	12	3·0	1·8
18	Kanha-Lulliani	65	14·5	2·7	1·6
19	Athilpur	33	11	2·2	1·3
20	Chunian	26	8	2·3	1·4
	Canal:				
21	Above Katha Weir ..	1700	86	7·3	2·71
22	Above Jothu Weir ..	1700	91	7·0	2·70
23	Above Tarn Taran Weir	1500	76	7·2	2·74
24	At Bhuchar	1250	82	6·2	2·47
25	Above Bhuchar Fall ..	940	81	5·1	2·28
26	Katora Canal (1892) ..	633	50	5·2	2·52
27	Katora Canal (1893) ..	924	55	6·5	2·59

From these data Kennedy deduced a relation between mean velocity and depth, which he expressed in the formula $V_o = 0{\cdot}84\, d^{0{\cdot}64}$. Plotting the data logarithmically, in Fig. 1, we see that the formula agrees well with the data. He rejected cases Nos. 21 to 25 of Table I., which are marked by crosses, and also Nos. 26 and 27, which are marked by crosses enclosed in circles, on the ground that these represented channels which were not in settled silt *régime*. Kennedy did not measure the surface slopes of his experimental channels, nor calculate the value of Kutter's coefficient N. This was a serious omission, which has caused much uncertainty, ever since, in the practical utilisation of his formula. He did not measure even the velocities of current; but, to use his own words, "The mean velocity of the stream was derived from the known 'full supply' discharge and the measured cross-sectional area of channel. All the data refer to these 'full supplies,' which are somewhat greater than the average discharge, and less than the flood discharge. According to the system of distribution adopted, each distributary was, as far as possible, always discharged with its full supply, the total discharge of the canal being only sufficient to provide at one time for, say, nine out of the twelve minor channels. In all the channels this full supply will bear a more or less constant ratio to the average. The average discharge might equally well have been taken, but the results will be much more useful if they are directly applicable to the full supply required."

In this last remark Kennedy showed the same misconception as to the influence of width of channel on the silt-bearing power of the stream, which he stated more explicitly in the words:—"The bed width has no place in the equation connecting the depth *d* and the mean velocity V_o," for it can be shown that in a channel of given width, gradient, and rugosity, there is only one dimension of depth that will satisfy his V_o formula. By intelligently determining the "full supply depth" of each channel, Kennedy did, in fact, fix also the width requisite for good *régime*. According to his data, his selected channels, of over 250 cusecs capacity, were vertical sided, whilst the smaller ones had side slopes of ½ft. horizontal to 1ft. vertical. These are not normal conditions, for flatter side slopes are more usual. Probably the fact that Kennedy's canal sites were all immediately upstream of weirs or masonry overfalls, accounts for their abnormal verticality of sides. Anyhow, since side slopes are usually variable, it is better to discuss cross-sectional dimensions in terms of mean width *w* and average depth *d*, so that area of waterway = *w d*, than in terms of bed width *b* and depth. That the mean velocity V of a stream varies, *ceteris paribus*, with its mean width *w* is indisputable; for if *d* be constant, the hydraulic mean depth *r* varies with *w*, and V varies with *r*. This being the case, it remains to explain why Kennedy's formula, which makes V_o dependent on *d* only, has received as much acceptance in the past as it has.

The data of Kennedy's Selected Channels Nos. 1 to 20, as presented in Table I.—but omitting Nos. 21 to 27, which were rejected by him—are reproduced in Table II., with mean widths *w* substituted for bed widths *b*, *w* being = D/V *d*. The "canals," over 250 cusecs in discharge, are grouped separately from the *rajbahas*, of lesser discharge, for convenience of scrutiny. No. 3 canal is excluded, as being identical with the mean of Nos. 1 and 2. Columns are added to show V_o, *r*, and values of *d* raised to various indices.

Table II.

Serial No.	Discharge (D)	Mean width (*w*)	Average depth (*d*)	Mean velocity (V)	$V_o = \cdot 84\, d^{\cdot 64}$	Hydraulic mean depth (*r*)	$\sqrt{r}$	$\frac{\sqrt{r}}{V_o}$	$\frac{d^{\cdot 61}}{\sqrt{r}}$	$\frac{d^{\cdot 57}}{\sqrt{r}}$	$\frac{d^{\cdot 55}}{\sqrt{r}}$	$\frac{d^{\cdot 66}}{\sqrt{r}}$
1	1700	86	6·8	2·90	2·864	5·87	2·42	·845	1·408	1·231	1·186	1·465
2	1700	85	7·0	2·86	2·918	6·00	2·45	·840	1·418	1·237	1·192	1·474
4	1500	80	6·6	2·83	2·806	5·69	2·39	·852	1·404	1·226	1·184	1·455
5	1250	68	6·7	2·75	2·838	5·59	2·36	·832	1·429	1·254	1·208	1·488
6	1250	70	6·5	2·81	2·780	5·36	2·32	·835	1·432	1·254	1·207	1·483
7	940	66	5·6	2·55	2·530	4·79	2·19	·866	1·376	1·219	1·178	1·423
8	700	61	5·0	2·33	2·350	4·30	2·07	·881	1·350	1·208	1·169	1·398
9	650	48	5·5	2·40	2·500	4·52	2·13	·852	1·490	1·249	1·197	1·446
10	390	36	4·8	2·25	2·291	3·79	1·95	·851	1·401	1·256	1·215	1·444
Average canals		66·7	6·06	2·63	2·65	5·1	2·25	·85	1·402	1·236	1·193	1·453
11	220	23	4·5	2·15	2·198	3·24	1·80	·818	1·457	1·311	1·272	1·499
12	142	19	3·9	1·90	2·005	2·77	1·66	·830	1·436	1·307	1·271	1·479
13	138	19	3·6	2·04	1·906	2·61	1·62	·850	1·404	1·278	1·247	1·437
14	120	15	4·0	2·00	2·037	2·61	1·62	·795	1·502	1·358	1·321	1·541
15	85	17	3·0	1·70	1·694	2·22	1·49	·880	1·356	1·255	1·228	1·386
16	75	15	3·0	1·70	1·694	2·14	1·46	·861	1·381	1·280	1·253	1·414
17	70	13	3·0	1·80	1·694	2·05	1·43	·844	1·411	1·308	1·280	1·444
18	65	15	2·7	1·60	1·585	1·99	1·41	·893	1·337	1·241	1·227	1·365
19	33	11	2·2	1·30	1·390	1·57	1·25	·930	1·321	1·264	1·242	1·346
20	26	8	2·3	1·49	1·429	1·46	1·21	·847	1·410	1·330	1·306	1·430
Average rajbahas		15·5	3·22	1·76	1·76	2·27	1·50	·85	1·432	1·293	1·264	1·434

From this table we see that, for large and small channels alike, the mean value of the ratio $\frac{\sqrt{r}}{V_o} = 0{\cdot}85$, and of the ratio $\frac{d^{\cdot 61}}{\sqrt{r}} = 1{\cdot}402$ is constant; and that this constancy does not hold good when *d* is raised to a power of index other than 0·64. It is this that forms the chief characteristic of Kennedy's formula, though Kennedy himself was probably not conscious of it. For the factor *r* contains the element *w* as well as *d*. Thus we may say: $V_o = 0{\cdot}84\, d^{\cdot 64} = c\sqrt{r}\, s$. And if $d^{\cdot 64} = 1{\cdot}402\sqrt{r}$, we infer that $\frac{V_o}{\sqrt{r}} = c\sqrt{s} = 1{\cdot}178$, a constant. Which implies also that *c*, and therefore also Kutter's N, varies inversely with some function of *s*. It is unfortunate, therefore, that Kennedy did not determine the *s* or the N of his selected channels. From the equation $V_o = 1{\cdot}178\sqrt{r}$, we may deduce, for channels of rectangular section, in which $r = \frac{w\,d}{(w + 2d)}$, the figures set out in Table III.

For water depths ranging between 2ft. and 7ft., *i.e.*, within the range of dimensions of Kennedy's selected channels, the mean widths and discharges, thus deduced from his formula, are reasonable. But for depths greater than 7ft. the widths and discharges indicated by the Table III. are extravagant; and at the 12ft. depth *r* exceeds *d*. Which is absurd, and suggests a defect in Kennedy's empirical data, or in the structure of his formula.

Table III.

Water depth (*d*).	V_o.	$\sqrt{r} = V_o/1{\cdot}178$.	$r = \frac{w\,d}{(w + 2d)}$.	Mean width (*w*).	Discharge (D).
1	0·84	0·713	0·508	2·1	1·75
2	1·30	1·104	1·219	6·3	12
3	1·70	1·443	2·082	13·8	70
5	2·35	1·995	3·980	30	460
7	2·92	2·479	6·145	101	2056
9	3·43	2·912	8·480	294	9,060
10	3·67	3 1⅛	9·709	667	24,468
11	3·89	3 3⅛	10·903	2399	102,638
12	4·12	3·498	12·2⅛	—	—

The New Formulæ.

In these circumstances, a new system of hydraulic formulæ for *régime* channels is hereby offered for consideration.

Notation.—

w = mean width of waterway.
d = average depth of water.
$w\,d$ = area of cross sectional waterway.
V_w = critical, non-silt, non-scour, mean velocity.
D = discharge = $w\,d\,V_w$.
$\sigma = 1000\,s$ = surface fall in 1000ft.

Formulæ.—

$$\log d = 0{\cdot}434 \log w.$$
$$V_w = \log w\,d = 1{\cdot}434 \log w.$$
$$\sigma = \frac{1}{\log (D^2)} = 1000\,s.$$

The results of the formulæ are graphically depicted in Fig. 2, whereon are also plotted in small circles, the depths and means velocities of Kennedy's selected channels. It will be noticed that the lines $0{\cdot}434 \log w$ and $\log w\,d$ agree well with the log *d* and V of Kennedy's selected channels; and even with those, marked in crosses, of the channels rejected by Kennedy. The data of the Katora "Inundation" Canal, marked in crosses enclosed in circles, are notably quite as conformable as the rest. This canal offtakes from the river Sutlej, near Ferozepore, without the help of a weir across the river, at a point distant about 120 miles from the point of exit of the river from the Himalayas.

Since the logarithm of unity is zero, the formulæ for V_w and σ are modified to—

$$V_w = \log (w\,d + 1); \text{ and } \sigma = \frac{1}{\log (D + 1)^2}.$$

The curve $\log (w\,d + 1)$ is a hyperbola, asymptotal to $\log w$ and to $\log w\,d$.

The ratio of $\log w$ to $\log d = 2{\cdot}303$; the ratio of the hyperbolic to the common logarithm.

Table IV.

w (ft.)	*d* (ft.).	$V_w = \log (w\,d + 1)$.	D = $w\,d\,V_w$.	$\sigma = 1/\log (D + 1)^2$.	$\frac{V}{\sqrt{r\,s}}$	Kutter's (N).
2	1·351	·568	1·50	1·23	21·4	·0484
4	1·820	·918	6·70	0·564	49	·0325
8	2·466	1·318	26	0·350	57	·0266
11	2·83	1·507	47	0·298	64	·0249
17	3·42	1·772	103	0·248	72·3	·0235
23	3·900	1·958	176	0·223	77	·0229
50	5·46	2·438	666	0·177	87	·0221
70	6·32	2·646	1171	0·163	89·6	·0222
100	7·38	2·869	2,118	0·150	92·6	·0223
150	8·80	3·121	4,115	0·138	94·6	·0226
200	10·00	3·301	6,602	0·131	95·7	·0230
300	11·89	3·553	12,674	0·122	97	·0235
400	13·46	3·732	20,080	0·116	97·7	·0240

Within the range of dimensions of Kennedy's selected channels the formula [$V_w = \log w\,d = 1{\cdot}434 \log w = 3{\cdot}303 \log d$] is in agreement with his data. Within those limits, if we equate V_w with V_o, we may say: *Régime* mean velocity = $3{\cdot}303 \log d = 0{\cdot}84\, d^{\cdot 64}$. Whence we derive: $\log d = {\cdot}254\, d^{\cdot 64}$,

In Fig. 2 the curve $V_o = (0{\cdot}84\ d^{0{\cdot}64})$ has been plotted for comparison with log $(w\,d + 1)$. The formulæ shown in Table IV. determine all the hydraulic conditions of a *régime* channel—width, depth, velocity, gradient and discharge—whenever any one of these data is known or determined.

Kennedy's formula has received a certain measure of acceptance throughout the world, but difficulties are indicated by the fact that in different countries engineers have felt it necessary to tamper with the multiplier, or with the index, of d. Thus, the Madras engineers use the form $V_o = 0{\cdot}67\ d^{0{\cdot}55}$, and those of Burma prefer $0{\cdot}91\ d^{0{\cdot}57}$. In a certain Californian project, it is reckoned that $V_o = 0{\cdot}98\ d^{0{\cdot}64}$; whilst elsewhere we have seen the form $0{\cdot}95\ d^{0{\cdot}57}$ advocated. The Sind engineers seem to think that $0{\cdot}63\ d^{0{\cdot}64}$ is best for local consumption; whilst, quite recently, the engineers of the Sutlej Valley Canals in the Punjab have been toying with $V_o = 0{\cdot}67\ d^{0{\cdot}64}$.

There does not appear to be much merit in these variations of Kennedy's formula. None of them takes any account of the influence of w on V_o; whilst from Table II. it may be seen that $d^{0{\cdot}64}$ has at least the merit of a constant relationship with r, within the range of Kennedy's selected channels.

In his paper of 1894–95 Kennedy himself wrote: "The expression $V_o = c\,d^m = 0{\cdot}84\ d^{0{\cdot}64}$, not only gives the critical or non-silting velocity for any depth, but also the ratio between the mean velocity and the depth at which the silt-ratio p will be constant. It does not, from this consideration, seem probable that the constants c and m will vary greatly, if at all, on different canal systems. On the other hand, the value of p will vary with the character of the silt, and with its specific gravity."

The engineers of Madras, Burma, &c., above referred to, have been varying c and m, by way of dealing with p. That is not the best procedure. The "*régime* velocity" formula, if sound in structure, should remain constant, as a criterion for design. The silt charge p may most appropriately be controlled at the head regulator of each main or branch canal, or *rajbaha*, by a method which will be explained on another occasion.

For the present the new formulæ are offered to the profession as the most convenient, precise and rational method of determining not only d and V_o, but also s and N in terms of w in the design of "*régime*" channels.

The World's Production and Trade in Machinery.

(From a Correspondent.)

AT the request of the preparatory committee of the League of Nations for the world economic conference at Geneva, the Association of German Machine Construction Works—Verein Deutscher Maschinenbauanstalten—was asked, some time ago, to submit a communication concerning the situation of the highly-finishing industries represented by the Association. This request was complied with by the publication by the Association of a remarkable memoir under the title of the "Denkschrift uber die Maschinenindustrie der Welt," which deals not only with Germany, but also with the rest of the world. The Association is said to have placed the information it had collected before similar societies in other countries and asked their opinions, and the ascertainments made by those societies are stated to have differed only insignificantly from those of the German Association, so that the present memoir may be regarded, according to the German view of the subject, as a reliable source for forming an opinion of the situation of machinery construction in connection with the displacements which have taken place since the pre-war period.

According to abstracts published in the German newspapers, the memoir leaves out of consideration electrical machinery and boilers, but includes locomotives. On that basis the value of the production of machinery throughout the world is given at 13,550,000,000 marks in 1913, or, say, £677,500,000 if 20 marks are roughly assumed as being equal to one pound sterling, which figure is also taken in all other instances which follow. Of the total 50 per cent. is credited to the United States, 20·6 per cent. to Germany, and 11·8 per cent. to Great Britain, while the remaining 17·6 per cent. is allotted to all the other countries combined. It is assumed that, in 1913, the productive capacity in general was being fully utilised. Since the beginning of the war the productive capacity has been considerably extended, and it represented in 1925, a possible output of the value of 29,780,000,000 marks, or £1,489,000,000, on the same conversion basis, corresponding to a pre-war value of 19,860,000,000 marks, or £993,000,000. But the productive capacity was only utilised to the extent of 74 per cent. in 1925. The value of the actual output in that year was 22,060,000,000 marks — £1,103,000,000 — or 14,700,000,000 marks—£735,000,000—when reduced to pre-war values, or only 1,150,000,000 marks —£57,500,000—more than in 1913. In these figures are shown the world economic displacements during the past twelve years.

In actual production and based upon pre-war values Germany is said to have incurred a loss of 900,000,000 marks—£45,000,000—or 800,000,000 marks—£40,000,000—if applied to her post-war frontiers, and other countries a loss of from 100,000,000 marks to 200,000,000 marks—£5,000,000 to £10,000,000. On the other hand, as compared with 1913 Great Britain is stated to have secured in 1925 a gain of 400,000,000 marks—£20,000,000—and the United States an advance of 1,700,000,000 marks—£85,000,000. In 1925 Germany with a share of 13·1 per cent. occupied the third place, the United States having 57·6 per cent. and Great Britain 13·6 per cent. In this connection the memoir states that matters must not remain so, as Germany has a productive capacity of 16·9 per cent. of the total world capacity and is thus still in front of Great Britain

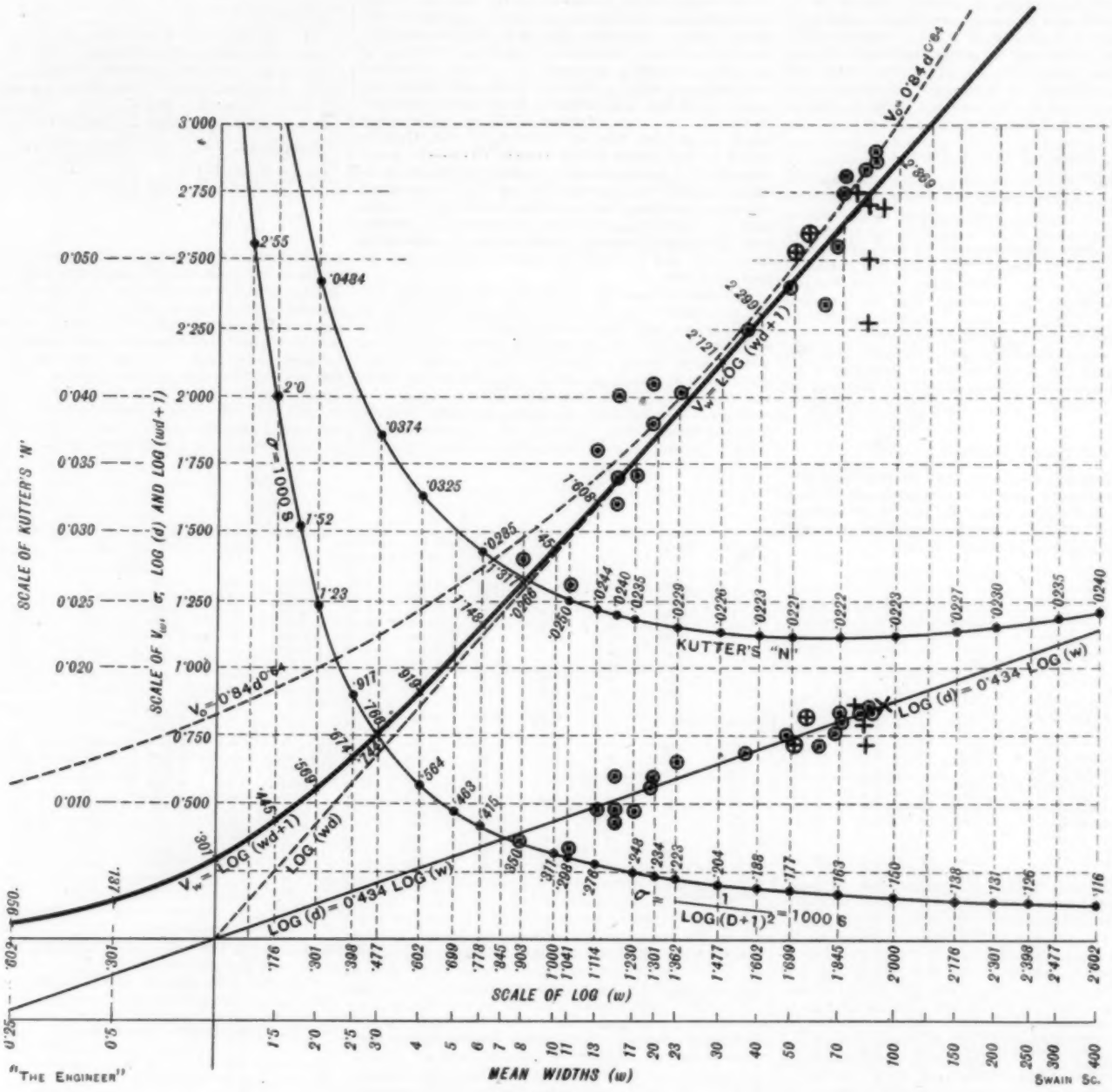


FIG. 2

with her 11·6 per cent., although being far behind the United States, which have 57·1 per cent. of the world capacity.

The memoir proceeds to observe that the machinery exports of the world show a similar development. In 1909 the exports of Great Britain exceeded those of Germany by almost one-third and those of the United States by about one-half. Down to 1913, however, it is submitted that England was slightly surpassed by Germany and almost overtaken by the United States. In round figures each of the three countries had about two-sevenths of the world machinery exports, while the final seventh was taken by all other countries. Since the war the situation has materially changed. It is true that the total world exports of machinery, which amounted to 2,537,000,000 marks—£126,850,000—in 1913, rose to 3,675,000,000 marks, according to the value of the times, but on the pre-war basis they were actually no more than 2,450,000,000 marks—£122,500,000. But of this total more than one-third—34·8 per cent. in 1925, as against 26·8 per cent. in 1913—was enjoyed by the United States, 24·4 per cent. by Great Britain, as compared with 28·4 per cent., and 20 per cent. by Germany, as contrasted with 29 per cent., while 20·8 per cent. was set down to all the other countries as against 15·8 per cent. in 1913. The retrogression of Germany in 1924 was even greater, but the figures for 1926 were expected to show an approach between the English and German figures.

Among the importing countries which have no machine production industry the memoir states that Asia shows both absolutely and relatively by far the greatest development in the imports as compared with the pre-war period, while Latin-America is below her pre-war level, and Africa and Australia have moved with fluctuations within their pre-war limits. What has taken place is consequently not so much a greater industrialisation of the raw material districts as a whole, as a transfer within these industrialising regions of the centre of gravity to the Far East. On the whole, the share of the foreign trade in the production has declined by fully one-fifth in 1913 to quite one-sixth in 1925, despite the increased exports into the countries becoming industrialised—solely through the falling off in the interchange between the machine making countries. In the opinion of the memoir this retrogression in the foreign machinery trade represents a particularly serious indication of a decline in the international distribution of work, upon which the modern development of world economy depends. In particular, the cause is attributed to the multiplication of Customs frontiers and the increase in the Customs walls, especially in Europe since the war. In addition there are the difficulties of passports, which greatly hinder the control of current machines and the activity of the erecting staff, and also the policy of some countries, such as Spain and Italy, in rendering it difficult for plant other than that made in the country to be used, while in other countries a more or less strong private propaganda is carried on against the use of foreign products.

The memoir proceeds to express the opinion that the process now in course of the industrialisation of the raw material countries which have no machinery industry of their own will give a special impetus to the machinery industry of the world from the moment when countries such as China and Russia, after overcoming their present troubles, get a complete connection with the world market.

As a result of the preceding considerations the memoir proceeds to argue that protective duties on machinery in the countries now being industrialised are unnecessary and would increase the costs of production in other branches, and finally prejudice the establishment of conditions which are essential for the growth of a machinery industry. Finally, the memoir arrives at the conclusion that the machinery industry of the world in general is not suitable for the formation of syndicates, but that this circumstance should not prevent international approach and co-operation. The mutual learning to know each other and the establishment of a personal feeling between the machinery industries of the various countries, it is submitted, would have the effect of obviating the mistrust frequently arising through ignorance and help forward to the conviction that the machine builders in all countries are co-operators in the progress of civilisation, and that the contribution of no country can be dispensed with without slowing down this progress.

The Re-conditioned Liner Empress of Australia.

ON Friday evening of last week, June 10th, after concluding successful trials, the Canadian-Pacific liner Empress of Australia, shown above, left the Clyde for Southampton, from which port the ship will take up her new commission in the company's Canadian Transatlantic service. A party of guests was invited by the owners to accompany the vessel on her trip round, and an excellent voyage was made, during which we had an opportunity of inspecting the refitted passenger accommodation and the new propelling machinery which has been built and installed by the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, Glasgow.

When, in 1922, we described this vessel in our issues of June 23rd and July 7th and 28th, the interest in the ship was chiefly centred around the then novel propelling machinery, which comprised twin-screw sets of high-speed combined impulse and reaction type turbines, that drove the propellers through hydraulic transmission gearing of the Föttinger type, steam being raised in fourteen water-tube boilers of a modified Yarrow design, working at 250 lb. pressure. Interest now centres on the excellent performance of the new geared turbine machinery of British design, which, according to the trial results—to which we shall refer later—has made the Empress of Australia the most economically propelled ship of her type on the ocean to-day.

Before going on to discuss the new machinery, however, the previous history of this re-conditioned ship may be briefly summarised as follows:—She was originally ordered for the South American service of the Hamburg-American Line, being launched from the Vulcan Yard at Stettin in 1913, and named the Tirpitz. Work on her was, however, not completed until after the war, when she passed into the hands of the British authorities, and was purchased in 1922 by Canadian-Pacific Steamships, Ltd., for its service between Vancouver and China. The liner has a length of 515ft., with a gross tonnage of 21,850. As refitted, she is arranged for carrying 400 first-class, 144 tourist and 632 third-class passengers, which, together with a crew of about 516, gives a total ship's complement of about 1700 persons. We need not refer in detail to her original propelling machinery, which was described and illustrated in our issues of July 7th and 28th, 1922. It will suffice to say that in service it did not prove very satisfactory, as the owners were unable to maintain the designed speed of 16½ knots, and the consumption of oil fuel was very high. As the vessel had only seen service for a comparatively short time, and as her passenger accommodation was of a very modern and luxurious type, it was decided by her owners that it would be advantageous to install in the ship new propelling machinery which would embody the most recent marine practice in steam turbine and single-reduction gearing design. At the same time an opportunity was taken to make such alterations in the passenger accommodation, particularly with regard to the tourist passenger and the third-class passenger public rooms and cabins, as would render the ship suitable for the North Atlantic trade, and also available for world tours.

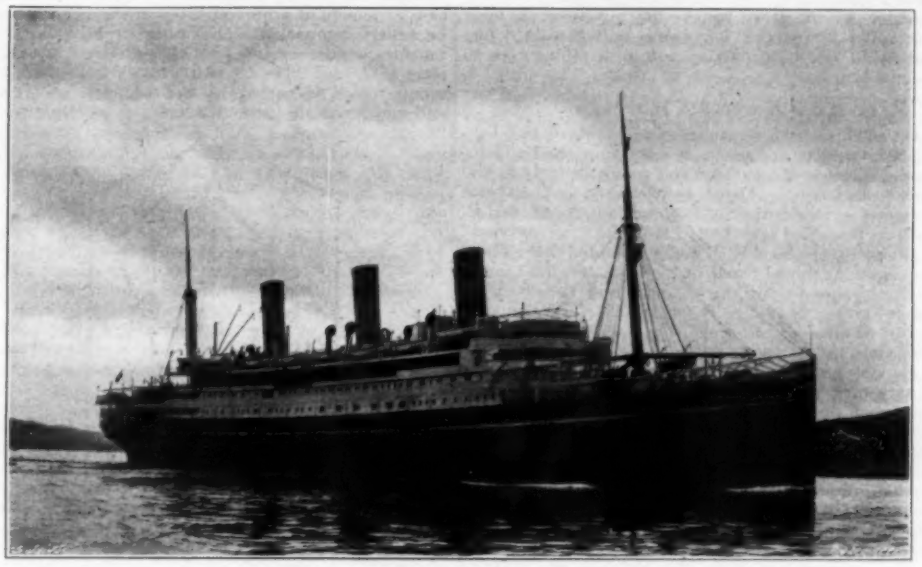
INSTALLING THE NEW MACHINERY.

The contract for refitting and re-engining the ship was placed with the Fairfield Shipbuilding and Engineering Company, Ltd., early in March, 1926. Owing, however, to the delays connected with the coal trade dispute, and the unavoidable industrial dislocation which followed, at the end of December last, many of the principal forgings for the turbines and practically the whole of the boiler material had still to be delivered. The owners were specially desirous that the date originally fixed for the delivery of the ship namely, June 6th, 1927, should not be exceeded, and they approached the Fairfield Company with a view to a combined effort being made to deliver the ship to date, in spite of nearly eight months lost by the strike. It was agreed to finish the ship to time, and the success of the concentrated and continued effort made may be judged by the fact that the reconditioned liner was handed back to her owners on June 7th, nearly five days before the date contracted for. Such a result was made possible by the closest co-operation between the technical staffs of the owners and builders, and by the extended hours which were worked at the yard. Actually, three shifts were worked on the refitting work aboard, and two shifts and overtime on the boiler shops, which increase in hours was agreed to by the men's union in view of the urgency of the work.

The new machinery, which has been constructed to the specification drawn up by the chief superintendent engineer of Canadian-Pacific Steamships, Ltd., Mr. John Johnson, comprises twin-screw single-reduction geared turbines of the Parsons type, built by the Fairfield and Parsons Companies, and six double-ended Scotch boilers with a single-ended boiler for the auxiliaries.

Before the new machinery could be installed in the ship it was necessary to remove the old. From the point of view of the arrangement of engine and boiler rooms, the Empress of Australia differs somewhat from standard British practice. As will be seen from our accompanying illustration, the vessel has three funnels. The positions of the two forward funnels, the second of which is about amidships, correspond to the positions of the forward and after boiler-rooms respectively. Some 64ft. aft of the second boiler-room is the engine-room, which has a length of about 40ft., with the auxiliary machinery-room of the same length further aft. The third or aftermost funnel is only a ventilating shaft. The main turbines were lifted through the engine-room hatch and the Föttinger gears were taken out of the auxiliary machinery-room and removed in the same manner. For the boilers the operation was not so simple, and it was made more difficult by very complicated pipe arrangements. There is a distance of about 80ft. between the centres of the forward and after boiler-rooms, with a similar distance from the centre of the forward boiler-room to the second cargo hatch of the forward cargo hold. It was decided to remove the old boilers and launch the new ones through this hatch, which was enlarged and cut away to the port side of the ship. Referring to Fig. 1, which shows the section through one of the rooms with the new boilers in position, it will be seen that, owing to the divided uptakes, it was impossible to lift the boilers out of the ship *in situ* without damaging the passenger accommodation, as corridors joining important public rooms run between the divided uptakes. It was decided to cut a passageway, which would just admit a new boiler on its launching ways, through the fuel bunkers between the boiler-rooms and then to continue this passage forward to a position below the cargo hatch previously referred to. Such a passage was, however, not large enough to take the water and steam drums of the German boilers without cutting them up, and over £1000 sterling was spent alone on oxygen and acetylene gas in reducing the old water-tube boilers to such sections as could conveniently be manipulated in the very restricted space. When the seatings had been prepared for the new boilers the uptake casings and air heater boxes were first assembled in the boiler-rooms and secured in position. The first boiler was then lowered on to launching ways, turned to enter the passage, and launched some 180ft. to a central position into the after boiler-room. It was then moved to the port side and the starboard boiler was next dealt with in a similar way, the centre boiler being brought in last. The passage between the boiler-rooms was then built up and the oil bunkers completed, and so advanced was the work on April 28th that the basin trial was run with the boilers of the after boiler-room, the work on the

THE CANADIAN-PACIFIC LINER EMPRESS OF AUSTRALIA



forward boilers then being still in progress. When that work was finally completed the launching passage and deck openings were closed up, and new deck erections for third passenger accommodation were begun. The operation which we have just outlined is one which we believe has never before been attempted by marine engineers, and certainly one which has not been carried out in anything like so short a time.

Main Propelling Machinery.

On page 658 we reproduce two views of the turbine and gear casing units, as erected in the builder's shops, showing the turbine and gear case ends in the upper and lower views respectively. The total designed service output of both units is 20,000 S.H.P. with a propeller speed of 125 r.p.m., an overload capacity of 21,000 S.H.P. being provided for. There are astern turbines fitted in high-pressure and intermediate-pressure turbine casings, and the designed astern power is about 14,000 S.H.P. Provision is also made in case of necessity to supply boiler steam direct to any of the turbines. Steam is supplied to the high-pressure units at a pressure of 220 lb. per square inch with 220 deg. of superheat. As will be seen from our illustrations, the three turbines are so grouped that each one drives the main gear wheel through an independent pinion, the high-pressure turbine being at the top of the wheel, the intermediate-pressure turbine on the inner side, and the low-pressure turbine on the outer side. The turbines are of Parsons reaction type, and end-tightened blading is employed on the high-pressure unit.

The seatings for both the turbines and gearing mark a radical departure from hitherto accepted turbine practice of fitting plate and angle bar stools. The lower view on page 658 shows very clearly the very deep lower part of the gear case, which extends downwards and is provided with a flat base giving a well-distributed foundation plate for attachment to the comparative shallow box seat built on the tank top and shown in Fig. 2, which is a longitudinal section through the main and auxiliary engine-rooms. The turbines themselves are situated a considerable height above the tank top to accommodate the underslung condenser, and necessitated high erections for their support. Again, a massive cast iron stool has been fitted at the forward end of each turbine unit—see page 658—which embraces the feet of each set of turbines and is carried down to the tank top.

The object of all this form of construction, which, it will be remembered, is similar to that previously adopted by Mr. Robert Traill, in the Fairfield-built motor liner Aorangi, is to reduce transmission of vibration, and to avoid as far as possible any racking stresses on the ship's structure. That practice has been wholly justified on the Empress of Australia, and nowhere on the turbine and gear case units could we feel sensible vibration when the units were developing nearly full power, and the ship was remarkably free from vibration in the passenger accommodation and deck erections. As shown in Fig. 2, the propeller shafts are carried through the auxiliary machinery-room to the shaft tunnels. To suit the new machinery, the run of the shafts was altered and the vertical rake was increased to 2¼t. 3in. at the forward end of a length of over 150ft., which entailed reboring the stern and fitting new stern tubes. The new propellers, which are of the four-bladed solid type, were supplied by J. Stone and Co., Ltd., of Deptford. As a result of experiments which were carried out at the William Froude National Tank at the National Physical Laboratory, Teddington, it was decided to alter the direction of rotation of the propellers, and make them inward turning when going ahead, as such an alteration was shown by the tank experiments to give an appreciable gain in propulsive efficiency, and also to give good manœuvring qualities. The trial results, referred to later, fully bear out the anticipations made. The main thrust blocks are of the Michell type, and are fitted with thrust indicators. Two Ford-Siemens electrical torsion meters of the latest design were provided on each shaft for the trials, and one of these instruments will remain on each shaft as a regular part of the vessel's equipment.

Some reference may be made to the condensers, which are of the Weir regenerative type, a full description of which, as applied for power station work, will be found in our issue of November 5th last. The marine condenser is boat-shaped—as shown on page 658—and there are two nests of tubes, an upper group, which is cooled by the second pass of water, and a lower group through which the cooling water is first passed. The steam has a clear passage right to the bottom of the condenser, and it reheats the condensate which rains down from the tube nests in the upper part of the condenser. The last portion of the steam flow takes place in an ascending direction, and surface is provided which acts as an air-cooling medium and is self-adjusting. In practice a temperature difference of only 7 deg. Fah. between the entering steam and the condensate is attained, with a sea temperature of about 50 deg. to 53 deg. Fah., and a vacuum of over 29in. The tubes are of 80 : 20 cupro-nickel, and were supplied by Allen, Everitt and Sons, Ltd., of Birmingham.

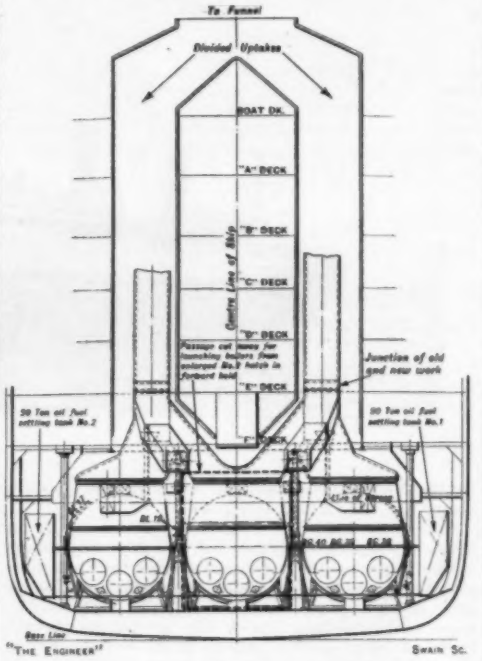


FIG. 1—BOILER-ROOM ARRANGEMENT

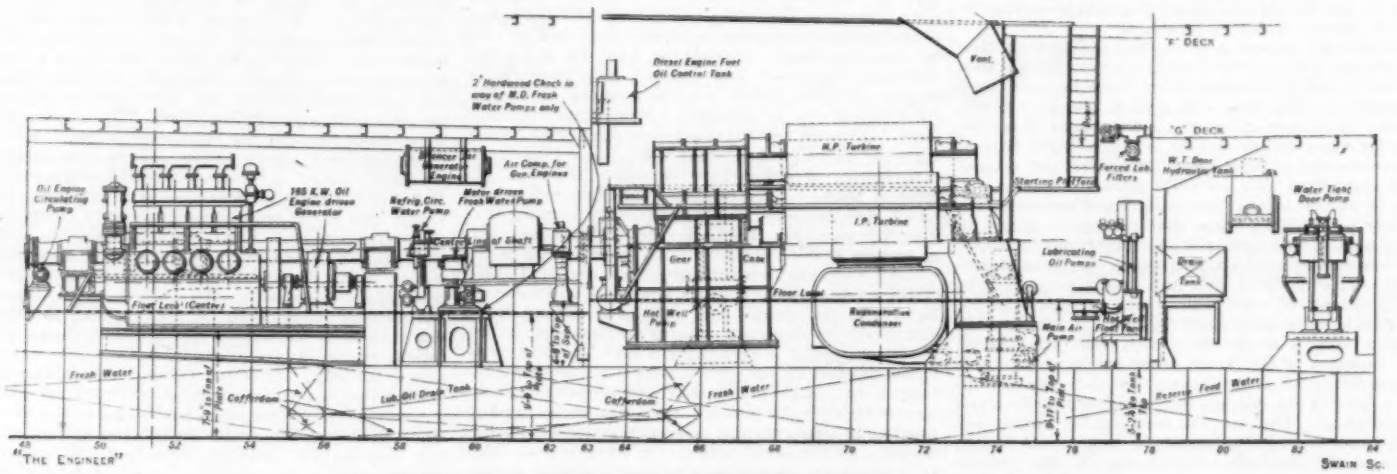


FIG. 2—LONGITUDINAL SECTION THROUGH BOTH ENGINE-ROOMS AT CENTRE OF SHIP

cupro-nickel, and were supplied by Allen, Everitt and Sons, Ltd., of Birmingham.

Auxiliaries and Pumps.

Practically the whole of the auxiliary machinery which was originally fitted has been removed and replaced by modern plant of British design. The main circulating pumps were supplied by Matthew Paul and Co., Ltd., of Dumbarton, and are driven by engines supplied with superheated steam. G. and J. Weir and Co., Ltd., Cathcart, supplied the two air pumps, which are fitted with jet augmentors, two pairs of feed pumps with a float control, any two pumps being capable of supplying all the boilers at full power, also an auxiliary feed pump, two hot-well pumps, and a direct contact feed heater. The lubricating pumps, four in number, are also Weir products. Drysdale and Co., Ltd., of Yoker, supplied the three electrically driven sanitary pumps; while J. H. Carruthers and Co., Ltd., of Polmadie, Glasgow, supplied the bilge and ballast pumps and the water service pumps for the oil coolers, which latter were built by Serck Radiators, Ltd. Two motor-driven fresh water pumps were supplied by Stothert and Pitt, Ltd., of Bath; while W. H. Allen, Sons and Co., Ltd., of Bedford, built the electrically driven cooling water pumps for the two 165 kW oil-engine-driven generator sets. One of these sets is shown in Fig. 2. It consists of a four-cylinder Allen-B. and W. type engine, with cylinders of 325 mm. bore and 440 mm. stroke, designed for an output of 250 B.H.P. at 300 r.p.m. As it was necessary to use a four-cylinder unit in order to come within the allotted space, specially designed balancing gear has been fitted as an additional precaution against vibration. The gear is of the Lanchester bob-weight type, and is accommodated in two longitudinal casings fitted to the engine bedplate. The two balancing gear shafts, one on each side of the engine, revolve in opposite directions, and are gear-wheel driven. This gear was, we understand, evolved jointly by the technical designing staffs of Fairfields and Allens. The engines, we noted, were remarkably free from vibration. The two sets are capable of supplying the full electrical load of the ship, but the four original turbine-driven generators have also been retained.

The Boiler Equipment.

As previously mentioned, the boilers are accommodated in two rooms, one amidships and the other forward. Illustration Fig. 1 shows a section of one boiler-room. The installation comprises six double-ended boilers—three in each boiler-room—designed for a working pressure of 220 lb. per square inch. Superheaters supplied by the North-Eastern Marine Engineering Company, Ltd., of Wallsend, are designed to give 240 deg. of superheat at the boiler stop valve, making a total steam temperature of about 615 deg. Fah. A single-ended four-furnace boiler, designed for the same working pressure, is placed in the forward boiler-room and serves to supply steam to the auxiliary machinery. It is also coupled to the main steam range. The steam mains are very long, and we noted that they were exceptionally well lagged, both in the boiler and engine rooms. All feed pipes are also asbestos-covered. The main boilers each have three furnaces, which are fitted with Todd oil burners. The equipment, supplied by Todd Oil Burners, Ltd., consists of duplex sets of oil fuel plant. Each set comprises two fuel pumps and three fuel oil heaters, one pump and one heater being a stand-by. One set is fixed in each boiler-room, and in the forward boiler-room there is an independent oil fuel unit for harbour use. The boiler-room fans are of the Howden electrically-driven type, and replace the old steam-driven fans. James Howden and Co., Ltd., also supplied the forced draught system, and the extra large air heaters, which are of the Howden tubular type. We noted that the gases leaving the heaters were at a temperature of about 340 deg. Fah. The boilers are fitted with an illuminated mirror device for smoke detection, and the fuel regulation is further facilitated by CO_2 recorders of the Mona marine type, which are fitted. Tube blowers by C. P. Parry, Ltd., of Liverpool, are provided on each boiler. The boiler plant appears to be capable of furnishing an ample supply of steam, and the units are so arranged that they can be utilised to the best advantage as regards change of load. Very complete protection against fire is provided by an equipment of Foamite extinguishers supplied by Foamite-Firefoam, Ltd., of London.

Trial Results.

The trials, which were carried out on June 6th and the following days, included progressive runs over the measured mile at Skelmorlie, a very complete fuel consumption trial, and also an endurance run. The ship had an average draught of about 26ft. 5½in. and a displacement of 21,800 tons and a mean speed of 20·345 knots was reached. Ordinary boiler oil of about 18,500 B.Th.U. gross calorific value was used during the trials. It was shown that the total fuel required for propelling purposes included the steering engine, but not deck services, was 0·69 lb. per S.H.P. hour under contract conditions. A consumption of

8·50 lb. of steam per S.H.P. hour was guaranteed for the turbines and actually 8·30 lb. was obtained, while the boilers showed an efficiency of 83 per cent. based on the gross calorific value of the fuel used. Some further particulars of the ten-hour consumption trial, which was run on Tuesday, June 7th, may be recorded. The turbines developed 20,440 S.H.P. at a speed of 128 r.p.m. Six doubled-ended boilers were in use with a total heating surface of 37,512 square feet. Per square foot of heating surface the water evaporated was 5·14 lb. per hour, and the oil fuel burned 0·384 lb. per hour, giving an actual evaporation ratio of pounds of water to pounds of oil fuel of 13·4. The oil fuel burned by each burner was 400 lb. The result obtained represents a very careful trial. The oil used was measured in calibrated settling tanks, and by a Basseler meter supplied by the British Liquid Meter Company, Ltd., in each boiler-room, while the feed water consumption was recorded by an accurately calibrated Glenfield and Kennedy water meter fitted in the forward engine-room. Before the trials were started over 20 tons of feed water were pumped into the boilers. The power was measured by the torsion meters already mentioned, and propeller thrusts were taken. As applied to the ship the results mean that in good weather a speed of 19 knots will be maintained at a total consumption for all purposes of 150 tons of fuel per day, whereas with the original machinery the maximum speed was only 17½ knots and the best sea speed on a number of voyages was 16½ knots on a gross consumption of oil fuel of 205 tons per day. The great economy which has been obtained by the combined factors of new turbines and gearing, high superheat, very efficient boilers, economical auxiliaries, and new propellers is perhaps best illustrated by saying that at the previous service speed of the ship, namely, 16½ knots, the present consumption of fuel would only be 100 tons, or rather less than half of that which was required with the original machinery.

Such a result, which, we believe, is an outstanding one in the annals of British marine engineering, reflects the greatest credit upon Mr. John Johnson, the chief superintending engineer of the Candian Pacific Steamships, Ltd., and also upon the Fairfield Shipbuilding and Engineering Company, Ltd., and Mr. Robert Traill, its engineering director, who has been closely associated with Mr. Johnson in carrying through the work. Even better results may be awaited from the new Canadian-Pacific liners equipped with combined water-tube and Scotch boilers and high-pressure 350 lb. geared turbine machinery, the first two of which should be ready for launching next year. On her arrival in Southampton Water on Sunday afternoon last the Empress of Australia was officially welcomed by Alderman P. V. Bower, Mayor of Southampton, and Admiral of the Port. She sails for Quebec on Saturday, June 25th, and on her second trip both the Prince of Wales and Mr. Baldwin, the Prime Minister, will travel on her to Canada. There is no doubt that the Empress of Australia will prove to be a very popular vessel on the Transatlantic service of the Canadian Pacific Steamships, Ltd.

Safety in Mines Research Station near Buxton.

THE new Safety in Mines Research Station on The Frith, near Buxton, was formally opened on Tuesday last, by the Viscount Chelmsford. The Frith, it may be explained, is near Harpur Hill, about 2½ miles south of Buxton.

The following account of this station and its inception is taken from a brochure which had been prepared for the use of visitors at the opening ceremony, and which is obtainable as Paper No. 34 of the Safety in Mines Research Board.

INTRODUCTION.

Following the pioneer observations and experiments of Galloway and the brothers Atkinson in this country, the Royal Commission on Mines, appointed in 1906, decided that research on coal dust explosions involving large scale experiments was essential. Experiments were eventually undertaken by a committee of the Mining Association of Great Britain, operations being begun in 1908, under the direction of Sir William Garforth, at the Altofts Colliery, Normanton, Yorkshire. An experimental gallery about 600ft. in length was constructed of old boiler shells, 7ft. 6in. in diameter, and a series of experiments made therein proved conclusively that dry coal dust could propagate an explosion without the presence of inflammable gas, and that the admixture of incombustible dust with the coal dust rendered it much more difficult to ignite.

In 1911 control of the work was relinquished by the Mining Association to the Government. An Executive Committee, known as the Explosions in Mines Committee, was appointed by the Secretary of State for the Home Department to investigate further the use of incombustible dust as a preventive of coal dust explosions with a view to its adoption in practice. The site at Altofts being no longer available, it became necessary to seek a new one at which to install the explosion gallery, which the Mining Association had lent. Ultimately, a site on the seashore near Eskmeals, Cumberland, was chosen and an experimental station for the prosecution of research, both laboratory and large-scale, on coal dust and other problems relating to safety in mines, was established there.

The transfer of the plant from Altofts to Eskmeals was effected during 1911 and 1912. In addition to the 7½ft. gallery loaned by the Mining Association, a smaller gallery about 3ft. in diameter was constructed, whilst plant for electric power, coal crushing and gas making, with joiner's and blacksmith's shops and laboratories equipped with the necessary scientific instruments, were erected. The work was continued at Eskmeals under the Explosions in Mines Committee until the latter part of 1914, when the Committee was dissolved and the experimental station was controlled directly by the Home Office. The present General Regulations regarding the use of stone dust in coal mines are based on the findings of the Explosions in Mines Committee.

On the outbreak of hostilities in 1914 the staff of the Eskmeals station was reduced to the barest working margin, and as time went on the work on mining problems was considerably restricted, its place being taken by researches relating to the war, carried out at the instance of the Ministry of Munitions and the Admiralty. By the end of the war, the buildings, plant and scientific equipment had seriously deteriorated, whilst the mining problems requiring solution had steadily accumulated. In December, 1919, therefore, a Departmental Committee of the Home Office was appointed: "To advise as to the nature and scope of the work to be carried on at the Home Office experimental station at Eskmeals, and as to whether any changes are desirable in the control and organisation of the station." This Committee's report, submitted on July 31st, 1920,* recommended an extended scheme of investigation into the various problems relating to mining dangers and, of several alternatives discussed, inclined most favourably to the view that, if funds were available, a new experimental station, on the lines of that at Eskmeals, should be erected in a more accessible position. On July 11th, 1921, the Safety in Mines Research Board was appointed, and, as a result of an application by the Secretary for Mines to the Miners' Welfare Committee, the latter entered into an undertaking to devote to research affecting the safety and health of coal miners a sum of £500,000, part of which was to be used for giving effect to the Committee's recommendation.

At the end of 1922 the position was that, on the recommendation of the Safety in Mines Research Board, the Miners' Welfare Committee had allocated certain sums for such additions to the plant and buildings at Eskmeals as would enable the experimental work to be carried on there for one or more years. The question whether a better site than that at Eskmeals could be found, despite its distance from the chief coalfields, remained open. Accordingly, the Eskmeals experimental station was temporarily reconditioned and experiments on coal dust explosions were carried out continuously during 1923 and 1924. The results, some of which are described in papers published during the last few years†, pointed unmistakably to the conclusion that a lengthy series of further investigations would be necessary. In these circumstances, the Board decided that, so far as large-scale research work was concerned, the best and in the long run the most economical course would be to abandon the Eskmeals experimental station and to erect a new one elsewhere. The Miners' Welfare Committee having agreed to make provision from the Welfare Fund for the new station, a search was made for a suitable site. The chief requirements were: The site must be in a central position near to the chief coalfields. It must be easily accessible to one or more of the University towns where technical research in connection with coal mining is in progress. It must not be near any working coal mine, experience at Altofts having shown that the experimental explosions were mistaken for mine explosions and caused alarm to the mining population. It must have a danger area in front and on both sides of the experimental explosion gallery, and this danger area must be wide unless a site surrounded by hills could be found. The position for the explosion gallery must be level for at least 1000ft., preferably 2000ft., and the surface must be such that the gallery could, if necessary, be buried. There must be good access to the site for heavy materials, either by railway or by road. A supply of water was essential and of gas desirable. There should be living accommodation for the staff within easy reach of the site.

Many sites were visited and examined, but were rejected on various grounds. In January, 1924, however, a suitable site was found in Derbyshire, 2½ miles south of Buxton, on an undulating moorland called the Frith. The site covers 411 acres and has a perfectly level position for the coal dust explosion gallery over a length of about 1500ft. There are also level spaces for other explosion galleries and for laboratories and workshops. Protection in front and on both sides of the site is afforded by rising ground, and there is a wide danger area free from houses and roads. A mineral railway runs close by, with a siding near one end of the explosion gallery. Water and lighting gas are obtainable from Buxton. No trouble is likely to be caused by the experimental explosions, since the site was used during the war for testing guns and for bomb practice, and there are quarries adjoining where blasting is constantly in progress. Like most sites having the necessary area and isolation and obtainable at a reasonable price, the elevation of the Buxton site is relatively high, about 1200ft.

In the layout of the Experimental Station provision has been made for all work that requires large-scale operations, such as that on mine ventilation, firedamp explosions, mining explosives and gob fires. The complete scheme, showing the position of the various buildings and the general layout of the plant and equipment as now existing, is shown in the engraving on the next page.

GENERAL DESCRIPTION OF THE STATION.

There are eleven principal buildings on the site. Four comprise what may be termed the administrative group, consisting of offices, stores, workshops, inquiry office and motor garage, four are observation stations, two contain ventilating fans and pulverisers, and there is a chamber of special construction intended for the study of gob fires. All are built of concrete with flat roofs.

Administrative Building. — The administrative building, consisting of offices, conference rooms, an analytical laboratory and chemical stores, is a single-storey building with a frontage of 180ft. and having two wings at either end, each 70ft. long. It forms the headquarters of the technical and administrative staff. The lecture and conference hall, which is the largest room in the building, measuring 30ft. by 45ft., can hold an audience of about 200. An analytical laboratory is at the opposite wing of the building. It is a large room measuring 31ft. by 30ft. and is fitted with a bench along one wall equipped with the usual laboratory fittings. The administrative offices occupy the middle portion of the building and provide accommodation for the Director and administrative and clerical staff.

Works Building.—About 150 yards from the entrance gate is the works building. This, the largest building on the station, measures 109ft. in length by 95ft. in width. It is rectangular in form with a corridor 12ft. in width running centrally its full length. The station light railway, referred to later, runs along this corridor. On each side of the corridor various stores and shops are arranged.

Battery House.—A battery house, 40ft. by 20ft., contains the storage batteries used for standby electric power supply. The present equipment consists of two sets of batteries at 110 volts of 290 and 360 ampère-hours capacity, so arranged that they can be run either in series or in parallel. These batteries are of particular value for use in experimental work when a constant and steady voltage is essential, and they provide a supply of electric current at times when the generating plant is shut down.

Power-house.—The power-house measures 40ft. by 35ft. It is equipped with three generating sets each comprising a four-cylinder vertical high-speed oil engine, direct coupled to a shunt-wound direct-current generator having an output of 20 kilowatts at 220 volts. Adjacent to the generating plant is arranged the control switchboard, consisting of three generating panels, a battery charging panel, feeder panel, and control panel for a Tirrell automatic voltage regulator.

Gas, Water and Electric Supplies.—Town gas and water supplies are obtained from the Buxton Corporation mains. These mains terminate at a point nearly three-quarters of a mile from the Experimental Station, and at a level of 250ft. below it. The water is pumped from there by an electrically driven three-throw pump installed in a concrete pump house. The electric current is transmitted from the Experimental Station to the pump house by overhead conductors, and the water is conveyed through a 2in. galvanised iron main to a steel water tank of 3500 gallons capacity, mounted on a steel structure 20ft. from the ground and installed close to the south side of the works block. The water pumping is automatically controlled by means of a float and switch fitted to the water tank, which in turn operates an automatic motor starter. The gas supply passes through a meter installed in the pump house. It is conveyed through a 2in. underground galvanised iron main to the Experimental Station, where it is distributed by 1¼in. underground pipes to the various buildings at which a gas supply is required. Electric supply for power and lighting is distributed over the station by overhead mains consisting of hard-drawn stranded copper conductors insulated with braiding and slung on stranded steel wires by means of raw hide slings.

Transport.—For the delivery and transport of goods a short siding to the Experimental Station has been taken from the High Peak line of the London, Midland and Scottish Railway, and adjacent to the siding an unloading dock of concrete, measuring 40ft. in length by 12ft. wide, has been constructed. Spanning the siding and unloading dock there is a 10-ton hand-operated cross-travelling gantry crane, which greatly facilitated the unloading from the railway wagons of the heavy plant and equipment installed on the station. Communication between the siding and unloading dock and the various outlying points of the station is provided by a 3ft. gauge light railway

* Report of Departmental Committee on Home Office Experimental Station, Eskmeals, 1921.

† See, for example, S.M.R.B. Papers Nos. 3, 13 and 14.

system. This railway runs the full length of both the 4ft. gallery and the 7½ft. gallery, and also connects with the works block and the explosives research and gob fire research buildings. The total length of line laid at present is 1350 yards.

Telephone System.—All the principal departments of the station are interconnected by an automatic telephone system. The equipment consists of thirteen instruments connected to a control panel capable of accommodating fifteen lines.

Coal Dust Explosions.

Two galleries have been constructed for research on coal dust explosions. One of these, 4ft. in diameter, is new and will be used for the systematic research work. The other, 7½ft. in diameter, will be used mainly for demonstration explosions.

Of the many important problems demanding attention two have been selected for immediate study. The first deals with the possible effect of the presence of small percentages of fire-damp in the air on the liability to ignition of mixtures of coal dust and incombustible dust. The results obtained by previous workers are at variance on this question, and there is need to supplement the experiments of the Explosions in Mines Committee at Eskmeals (see Sixth Report of Explosions in Mines Committee, 1914).

Following upon this, a study will be made of the effect of small openings in the gallery on the ease of propagation of coal dust explosions. A series of experiments with openings in the 7½ft. gallery was carried out at Eskmeals in 1924, and the results obtained were important in affording a guide to the conditions most favourable or unfavourable in practice to the inception and development of a coal dust explosion.‡ In the 4ft. gallery with new and better instruments at the staff's disposal the investigation will be continued under more favourable conditions than at Eskmeals.

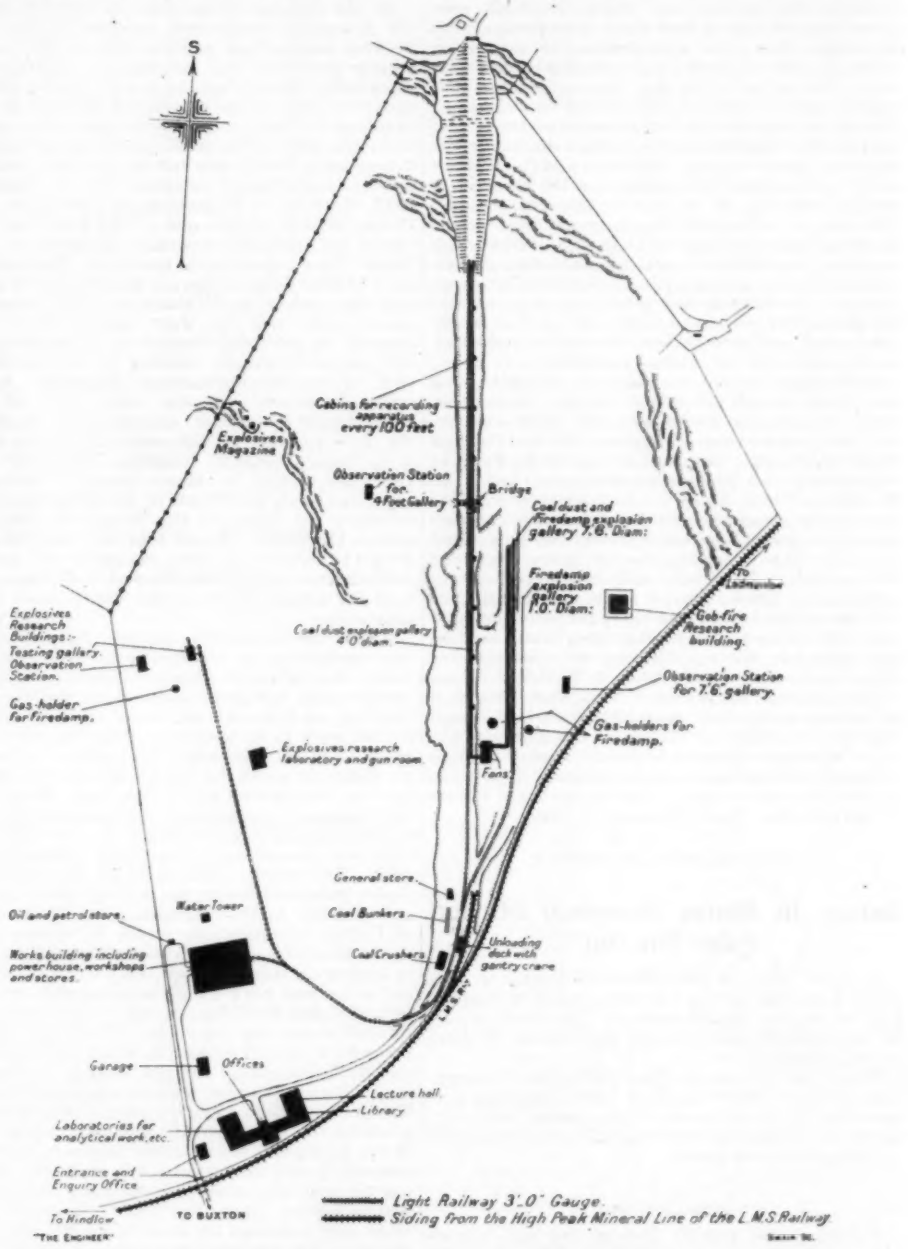
4ft. Explosion Gallery.—The 4ft. gallery runs nearly due north and south along a dismantled portion of the old Cromford and High Peak mineral railway track. The gallery is made up of forty sections of mild steel tubing, each 25ft. long, with walls ⅜in. thick. Each section is built up from three rolled sheets, bent to an arc of 120 deg. and electrically butt-welded together inside and outside. Thick flanges are welded to the ends of each section, a steel packing ring and two metallic asbestos gaskets being inserted between adjacent flanges, so that the tube formed by bolting together the forty sections is air-tight. Each section of the tube has been tested by hydraulic pressure up to 500 lb. per square inch. The gallery is supported about 9in. clear of the ground level on concrete cradles cast to the curvature of the tube, tarred felt being interposed between the steel and the concrete to reduce corrosion at the contact surfaces. As a safeguard against possible distortion by "whipping" during an explosion, two steel straps are passed over each section and fastened to rag bolts cemented into solid rock.

The southern end of the gallery is open, whilst the northern end is fitted with a four-way piece from which a fan drift runs at right angles. The drift can be closed by a valve operated by a steel shaft, which moves freely through metal bushes, one mounted on the fan drift and the other on the side plate of the four-way piece. The valve is a steel disc, 3½ft. in diameter. From the perimeter of the disc small segments are cut and corresponding segments are offset on a steel ring of 3ft. 2in. internal diameter, clamped between the fan drift and the four-way piece. After pushing the valve home a slight turn of the steel shaft meshes it in its seating and a cotter through the shaft on the outside of the gallery secures it in position. The remaining arm of the four-way piece is covered by a removable blank. The ventilating fan installed is capable of creating an air current of 1200ft. per minute, through the gallery in either direction.

The overall length of the gallery, inclusive of the length of the four-way piece and the packing between successive sections, is 1008ft. Midway along its length the gallery runs for some distance through a shallow cutting. The instrument cabins are built of steel plate on angle iron frames, and are firmly mounted on concrete foundations. They are not fastened to the gallery, but are in close contact with it. In each cabin a horizontal strip, 1ft. wide, has been removed from the side abutting on the gallery, so that the latter is exposed within each cabin to enable the recording instruments to be attached to the gallery. Each cabin contains a United States Bureau of Mines manometer, the pressure tubes of which are connected to plugs screwed into the side of the gallery. The distance separating the pressure tubes of successive manometers along the gallery is 100ft.

7½ft. Explosion Gallery.—The 7½ft. gallery runs parallel to the 4ft. gallery, but on a lower level. It has been built up of sections taken from the gallery used at Eskmeals, only the strongest being chosen. Each section is from 28ft. to 30ft. long, and the total length of the gallery is 410ft. This gallery is mounted on concrete blocks similar to those used for the 4ft. gallery, two being provided for each section and one for a four-way piece which is bolted at one end and connects with a fan drift.

Firing Stations.—Separate firing stations have been erected for the two galleries. These are similar buildings of concrete, measuring 30ft. by 10ft. Water, gas and power mains have been laid to the building from the works block, and the arrangement of its interior fittings makes it self-sufficing for the complete control of the experiments and the subsequent examination of records. One end of the building is partitioned off to form a dark room for the development of the photographic pressure records, whilst the other end accommodates an instrument control panel, a recording chronograph and a manometer calibration apparatus. An electrically driven siren has been mounted on the roof of the firing station to give warning when an experiment is in progress. In addition, a flagstaff has been erected on high ground immediately behind, so that the danger flag, when hoisted, can be seen from any portion of the site. The firing station for the 7½ft. gallery is situated about 30 yards to the west of that gallery.



THE SAFETY IN MINES RESEARCH STATION NEAR BUXTON

Ventilating Fans.—The fans serving the explosion galleries have to perform two functions, that of cleaning the gallery of fumes, dust and soot in as short a time as possible after a coal dust explosion, and that of producing a current of air, in either direction, if required during the course of an explosion.

The fan for the 4ft. gallery is a 30in. Keith fan fitted with a sheet steel housing, having a flanged outlet 30in. by 24in. and a tapering chimney 12ft. long. The inlet is of 36in. diameter. The fan is fitted with two dampers operated by one lever. By a single movement of the lever one damper closes the fan drift and simultaneously opens an inlet to the air. A second damper closes the chimney and opens a second chimney, through which the air is passed into the gallery. In this manner the direction of air current can be quickly reversed. The impeller of the fan is mounted direct on the shaft extension of a 20 H.P. variable speed shunt-wound motor, the speed of which can be regulated by field control up to 600 r.p.m. when operating on a 220-volt direct-current supply circuit. The motor is supported on a wrought iron bed-plate stepped down to take a pedestal which carries the fan bearing outside the fan casing.

The fan used for the 7½ft. gallery is a single inlet Sirocco fan of 6ft. diameter, which, when running at 800 r.p.m., has a capacity of 120,000 cubic feet of air per minute. Both fans are housed in a building erected midway between the ends of the two galleries. The fan drifts lead out from opposite sides of the house.

Pulverising Plant.—The pulveriser, a standard equipment, was in use at the Eskmeals station. In practice, it has been found capable of preparing dust, from any coal, of fineness such that at least 85 per cent. will pass through a 200-mesh sieve—I.M.M. standard. Small coal is fed by hand into a hopper fitted with an adjustable delivery plate. From the hopper the coal passes into a steel-lined pulverising chamber fitted with twelve beaters rotating at a high speed about a central shaft. The coal is ground between the beater heads and the steel lining of the chamber, and a small fan mounted on the extremity of the central shaft removes the fine dust and projects it upwards through a duct into a cyclone collector fitted with closely woven air release bags. The fineness of the dust delivered can be varied by adjustment of the air inlet ports and of the rate of coal feed from the hopper. By these means compensation can be obtained for the wide range of friabilities encountered in different coals, and a constant standard of fineness can be maintained.

Apparatus for Determining the Velocities and Pressures of Explosions in the 4ft. Gallery.—A study of the development of a coal-dust explosion demands the determination, at as many points as possible in the path of the explosion, of the speed of propagation of flame, the rate of development of pressure and the maximum pressure attained. Brief reference has already been made to the instruments with which the gallery has been equipped for making these measurements. A general description of each will now be given.

The Bureau of Mines manometer, which it has been decided to use instead of the B.C.D. manometer

‡ See S.M.R.B. Paper No. 14. "Coal dust explosions. The effect of the release of pressure on their development," by H. P. Greenwald and R. V. Wheeler.

hitherto employed, is the standard instrument in use at the Experimental Mine of the United States Bureau of Mines. It is a sensitive pressure gauge of the diaphragm type, and yields a continuous photographic record of the changes of pressure occurring at the point where it is installed. Each manometer is calibrated separately by subjecting it to a series of known pressures, both positive and negative, the deflection corresponding to these pressures being accurately measured after each series of tests. From the data so obtained, a chart is plotted for each manometer, from which the deflections observed during experiments can be directly translated into terms of pressure.

In a coal dust explosion the most convenient zero point of time on the manometer charts is the moment at which the cannon shot that caused ignition is fired. This is not registered directly on the chart, but is recorded indirectly by a sudden deflection from the pressure zero line, caused by the arrival at the manometer of the shock wave sent out by the cannon shot. The intervals of time which elapse between the firing of the shot and the arrival of the shock wave at the respective manometers can be determined once and for all by experimental methods which need not be considered here.

Flame Circuit Breaker.—The apparatus used for measuring the speed of flame, which is fitted to the crown of the gallery at intervals of 100ft. from the closed end, consists of a bronze plug screwed with a square thread so as to fit a bronze plate which is bolted to the gallery. The upper part of the plug body is shaped to a hexagon, in order that the plug may be screwed down tightly against a copper-asbestos washer which is interposed between a flange on the body of the plug and the planed surface of the plate. Passing through the plug and insulated from it are two stout steel rods which project 3in. within the gallery. Their lower ends are provided with terminals for clamping into position a short piece of fine-gauge tin wire which is subsequently broken by the flame of the explosion. The upper end of each rod makes positive contact with the brass socket of a watertight wall plug which is screwed to the surface of the hexagon. Connection between these sockets and those of the cable connector projecting from the plating of the instrument cabin is completed by a length of twin cable provided with suitable plugs. This is kept in the cabin when not in use, the cable connector and the wall plug being covered by screw-on caps.

Chronograph.—The chronograph which registers the speed of revolution of the manometer drums and the moments at which the screen wires of the circuit breakers are fused by the flame of the explosion, has been specially designed to enable these time intervals to be measured with great accuracy. The instrument consists of a long cylinder which revolves freely on a horizontal axis and is rotated at uniform speed through gearing by an electric motor. The surface of the drum is covered with a sheet of smooth paper to which a thin coating of soot has been given by means of a smoky flame. Fixed parallel to the axis of the drum is a bar which carries twelve Deprez indicators. On the interruption of the current the tip of the stylus moves in a direction perpendicular to the direction of rotation of the drum and, in so doing, makes a mark on the smoked surface. One indicator is connected in series with an electrically controlled tuning fork and inscribes a mark on the smoked surface every fiftieth of a second. Another forms part of the ignition circuit and registers the instant at which the cannon shot is fired.

Electrical Connections of the 4ft. Gallery.—Sixteen electric circuits are used in operating the instruments on the gallery.

Power for the manometer motors is obtained from a storage battery at the works block. Since a perfectly steady voltage is essential for the uniform running of the motors, the use of this battery when required is reserved solely for the work of the 4ft. gallery. The small glow lamps which supply the light for the registering spot of the manometers take 2 ampères each at 4 volts. The total load on this circuit is thus 20 ampères, which would necessitate the use of inconveniently heavy cable if the required current were to be taken from the main supply of the station without excessive voltage drop. An 18-volt storage battery placed behind the control panel is therefore used. The eleven chronograph circuits are operated in parallel from a single 6-volt accumulator. One circuit, called the "ignition circuit," is used to register on a chronograph the instant at which the cannon shot is fired. The remaining ten circuits are used to register in a similar manner the rates of revolution of the manometer drums in the ten instrument cabins and the moments at which the screen wires of the flame circuit breakers are destroyed by the flame of the explosion. The energy required for firing the cannon shot is drawn from the firing station mains (200 volts) through a limiting resistance, so that ample pressure is available, if required, to overcome any resistance adventitiously introduced into the circuit when connections are being made inside the gallery to the leads of the electric fuse heads. Light has to be provided within the gallery when dust is being laid before or swept out after an experiment. The leads are distributed from cabin No. 5 to cabins Nos. 1 and 10 through the junction boxes in the intervening cabins, a tapping being taken in each cabin to a cable connector fixed in the end plating. The firing station is connected by telephone with all the instrument cabins, the leads passing first to cabin No. 5 and thence through wall plugs fixed in the remaining cabins. Communication by means of portable instruments can thus be made between any two cabins or between any cabin and the firing station.

Fire-damp Explosions.

7½ft. Explosion Gallery.—In addition to its use for coal dust explosions, the 7½ft. gallery is used, in conjunction with a 1ft. gallery, for researches on fire-damp explosions. These researches are complementary to those that are being carried out on a smaller scale in the Board's laboratories at Sheffield.

The two more important researches which have been put in hand are: (1) On the projection of flame by a firedamp explosion, following up the laboratory work carried out by M. J. Burgess ("Firedamp Explosions: The Projection of Flame," S.M.R.B. Paper No. 27); and (2) on the effect of restrictions in the path of flame on its speed of propagation, in continuance of the work of W. R. Chapman and R. V. Wheeler ("The Propagation of Flame in Mixtures of Methane and Air: The Effect of Restrictions in the Path of the Flame," *Journ.* Chem. Soc., 1926, 2139).

For the former work the 7½ft. gallery is being used. A 30ft. length of the gallery, closed at one end, is separated from the remaining sections by a sliding shutter. The explosive mixture of firedamp and air is contained within this 30ft. section. When the shutter is raised unrestricted communication is made between the explosive mixture and the air in the remainder of the gallery. Mechanical devices, electrically controlled, are employed to raise the shutter and to cause the automatic passage of an electric spark at the closed end of the gallery as soon as the shutter is fully open. The flame produced passes beyond the original confines of the mixture and into the remainder of the gallery, the distance to which it is projected being measured.

The mixture of firedamp and air is prepared by admitting the required volume of firedamp from a calibrated gasholder into the 30ft. section of the gallery, which is by-passed throughout its length by a 3in. diameter pipe connected with a small circulating fan. The contents of the 30ft. section are continuously circulated through the by-pass until a homogeneous mixture has been obtained as determined by analysis.

1ft. Explosion Gallery.—The 1ft. gallery is laid parallel to the 7½ft. gallery. It is composed of sixteen sections, each 18ft. 9in. long, bolted together to form a continuous tube, 300ft. long, supported on concrete blocks in a manner similar to that used for the 4ft. and the 7½ft. galleries. The tube is by-passed throughout its length by a 2in. pipe, and there is a circulating fan for the preparation of explosive mixtures within it, as described for the 7½ft. gallery. Two gas-holders of 3000 cubic feet and 2500 cubic feet capacity respectively, for storing firedamp, have been erected close to the explosion galleries. The firing station, erected near the 1ft. gallery, is a concrete building measuring 30ft. by 10ft. It is provided with a dark room and an instrument bench, and is similar to the firing station for the 4ft. gallery described earlier in this paper. The windows are so arranged that both ends of both galleries can be observed. For experiments in which the speed of flame is to be measured, a chronograph has been devised in the design of which certain features of the Mettegang recorder have been adopted.

Coal-mining Explosives.

The researches on mining explosives are carried out in a group of buildings, consisting of a research laboratory and gun room, in which photographic methods are used to investigate the flame and the pressure waves sent out by an explosive, and an explosion gallery and observation station where the igniting power of explosives under different conditions of detonation is tested directly by firing them into inflammable mixtures of firedamp and air.

Explosives Research Laboratory.—The explosives research laboratory is a concrete building, 20ft. by 10ft., containing photographic apparatus consisting of a rotating film—or, alternatively, a fixed plate—camera, and a brilliant source of illumination provided by a mirror arc lamp of the type used for kinema projection. A spark gap in parallel with a leyden jar, charged by means of a two-plate motor-driven Wimshurst machine, may also be used as the illuminating source.

In the wave-speed camera the photographic film, 7 cm. wide, is stretched and secured on a drum of duralumin, exactly 1 m. in circumference. The drum is mounted in the camera with its axis horizontal, so that the film moves vertically downwards past the lens. It is rotated by an electric motor with belt drive, the average number of revolutions being 70 per second, so that the peripheral speed of the film is 70 m. (220ft.) per second. The camera is used for—(*a*) direct flame photography; (*b*) schlieren photography; (*c*) photography of the products of detonation.

Explosion Gallery and Observation Station.—The explosion gallery is made up of two sections, each 30ft. long and 6ft. in diameter, mounted on four concrete blocks. One end of the gallery is fully open and the other is fitted with a plate, in the centre of which is a circular hole, 12in. in diameter. This hole is closed during an experiment by the mouth of the cannon in which the explosive is detonated, a rubber washer serving to make a gas-tight joint. The cannon is mounted on a carriage on rails on a concrete platform, and can be moved away from the end of the gallery for loading and cleaning. The section of the gallery at this end forms the gas chamber and can be partitioned off from the other section by a diaphragm of oiled paper which is passed between the two and secured by a movable flange and locking ring, gas-tightness being secured by means of rubber washers. The gas chamber is fitted with additional release doors at the top, the main release of pressure when the explosive is fired being by the rupture of the oiled paper diaphragm. Two strong glass windows in the front of the gallery allow flame to be seen when ignition of the gas mixture takes place.

The charge is fired and the effect watched from the observation station, a concrete building, 60ft. from the gallery, provided with a horizontal window, 3in. wide, running its full length. The observation station also serves as a laboratory for weighing the charges of explosive and for gas analysis.

The gas chamber is filled with an inflammable mixture of the required composition by passing in the requisite amount of combustible gas, usually firedamp, the exact quantity being metered. A homogeneous mixture is obtained by circulating the contents of the chamber through a by-pass tube. Samples of the resulting mixture are withdrawn for analysis immediately before each experiment. A 2000 cubic foot gasholder is available for special experiments.

Gob Fires.

Arrangements have been made for research on a large scale into problems connected with the safe control of gob fires, following a suggestion made to the Board by Mr. E. O. Simcock, of Stoke-on-Trent. The building in which the experiments are carried out consists of a central chamber, 30ft. square and 8ft. high, simulating a mine goaf, with an air passage, approximately 6ft. wide by 7ft. high, circumscribing it. The goaf chamber and the air passage are connected by three doorways, each 6ft. square. At one corner there is a centrifugal blowing fan capable of delivering 10,000 cubic feet of air per minute against a pressure of 1in. water gauge.

Goaf Chamber.—The goaf chamber has been designed to withstand both the high temperatures to which it is subjected when a coal fire is burning in it and any violence due to a gas explosion. The concrete of which it is built was made with limestone aggregate, which is used extensively in the building of lime kilns by reason of its high heat-resisting qualities. Fireproof bricks cover the floor. The walls of the chamber are 1ft. thick, whilst the roof varies in thickness from 9in. at the centre to 5in. at the edges, and is reinforced with stout steel girders and expanded metal. Additional support is given to the roof by four pillars, each 1ft. square, composed of two steel girders strapped together and faced with concrete.

Four openings, each 8ft. square, have been provided at the corners of the roof for the release of explosion pressures. The openings are sealed normally by sheets of waterproofed asbestos roofing, $^1/_{32}$in. in thickness, each sheet being tightly clamped on steel framework built into the roof. Tests have shown that the pressure required to break these sheets is but a few pounds per square inch. The air course surrounding the goaf chamber is built of concrete, the outer wall and roof being 4in thick. A hinged door, containing two smaller wicket doors, is placed in the air course between two of the doorways communicating with the goaf chamber to allow of the initial distribution of air between the air course and the goaf chamber being altered according to the conditions it is desired to produce during an experiment. The temperatures within the goaf chamber are determined by thermo-couples enclosed in iron sheaths of variable lengths which pass through brass sleeves cemented into the roof.

According to preliminary laboratory tests on the use of pulverised coal recently carried out in America, the use of such a fuel would be both practical and economical in boilers of the Scotch marine type. It is estimated that firing expenses would be about half those entailed when burning low-grade coal in an ordinary furnace, whilst the radius of action of a coal-burning ship would be increased 15 per cent. when using pulverised fuel.

Over a period of five years the production in the United Kingdom of rolled wire rods, says the *Ironmonger*, has registered a continuous and very substantial decline, and this downward movement has coincided with a corresponding increase of imports. Production, which in 1923 reached 334,000 tons, dropped to 142,197 tons in 1926, representing a loss of 57·4 per cent., while in the same period arrivals of foreign rolled rods at British ports rose from 49,000 tons to 122,617 tons, or 149·9 per cent. At the end of 1926 imports had nearly caught up the home production, and they actually overtook it in the first quarter of the present year. The output of wire last year is estimated at 238,333 tons, as against 344,719 tons in 1923. Imports have risen from 35,753 tons in 1923 to 66,403 tons in 1926. Exports of wire have maintained their ground fairly well over the last five years, but the figures for the first four months of the present year indicate no expansion.

Institution of Electrical Engineers' Summer Meeting.

No. I.

THIS year the summer meeting of the Institution of Electrical Engineers, which commenced on Monday last, is being held in Newcastle, the headquarters of the North-Eastern Centre. Newcastle was to have been visited last year, but in consequence of the strike the meeting was abandoned, and the last occasion on which the Institution had a summer outing was in 1925, when Birmingham was visited. Whilst it cannot be said that the manufacture of electrical products is one of the stable industries of Newcastle and the neighbouring parts, it is common knowledge that a very fair amount of electrical manufacturing work is carried on in the locality, whilst the generation and distribution of electrical energy and its employment in the productive activities of the district have been developed to an extent which is probably unequalled anywhere else in the country. The Parsons steam turbine, which has had such a marked influence on electrical progress, and without which the large electrical schemes that have been put into operation would have been impossible, was, of course, evolved at Newcastle, where much important pioneer steam railway work was also done. Oliver Heaviside, one of the world's most famous electricians, was at one time employed by the Great Northern Telegraph Company at Newcastle-upon-Tyne, whilst Sir Joseph Swan, the inventor of the carbon filament lamp, was born at Sunderland. In and around Newcastle there is much to be seen that is of interest to electrical engineers, and there is every indication that the Institution of Electrical Engineers' meeting will be a very successful one. At the time of writing, however, only two works have been visited, and in the present article we shall confine ourselves to a few things that were brought to our notice during the course of those visits. The party, or rather a portion of it, met on Monday evening, June 13th, in the banqueting hall of the Central Station Hotel, where the visitors were afforded an opportunity of meeting the committees of the North-Eastern Centre and the Tees-side Sub-centre, and to become acquainted with each other. Something like two hundred and eighty people are taking part in the meeting, which up to the present has met all expectations.

On Tuesday morning, June 14th, some of the members inspected the Heaton works of C. A. Parsons and Co., Ltd., whilst others went over the Hebburn works of A. Reyrolle and Co., Ltd., and after luncheon at the Grand Assembly Rooms, Barras Bridge, those who visited the Parsons works in the morning proceeded to Reyrolle's works, and *vice versâ*. A good deal of interesting work is being carried out in the shops of Messrs. Parsons. Two 20,000-kilowatt turbo-generator sets to run at 3000 revolutions per minute are being built, and a 12,000-kilowatt single-cylinder machine, designed for the same speed—see Fig. 1—is being tested. This machine has a divided flow exhaust, which, as is well known, offers the advantage of reducing the leaving loss to a minimum without the adoption of a high peripheral speed or a tandem-cylinder design, which involves considerable overall length.

Another noteworthy machine that is in the course of erection is a turbo-blower for India, designed to deliver 50,000 cubic feet of free air per minute at a pressure of 18 lb. per square inch. The cast iron casing for a turbo air compressor—see Fig. 2—for a duty of 20,000 cubic feet of free air per minute at a pressure of 80 lb. was also on view, the impeller chambers being cast integral with the cylinder walls instead of in separate cells which have afterwards to be bolted together. The 33,000-volt, 31,250-kVA generator described in our last annual article created a good deal of interest, because its working pressure is about three times that of practically all other generators, although 30,000-volt machines of smaller capacity have been at work in Italy for over twenty years.

Last year an extensive testing and balancing house was completed at the Heaton works. It has concrete walls, 3ft. thick, and a 25ft. earthwork protection. By means of a 1000 horse-power Parsons' motor driving through gearing it is possible to run the largest shafts at speeds varying from 1500 to 9000 revolutions per minute. The largest alternator rotors may be run at 40 per cent. above their normal speeds and other speeds may be obtained for the purpose of balancing. The largest shafts and discs can be run at a speed of 50 per cent. above the normal value. When overspeed tests are in progress, the test house is, of course, completely closed, and no person is allowed in any part of the building, the motor being operated from another building some distance away by means of a remote control system. A speed-indicating device is fitted to the shaft, and each bearing is provided with an oil temperature alarm attachment. Other indicating and alarm apparatus is provided in the switch room. A view of this test house is shown in Fig. 3. For balancing alternator and turbine rotors dynamically at a low speed, a specially designed machine has also been erected in the factory.

One of the largest vacuum ovens in the country is now in use in these works for drying out alternators and transformers of all sizes. The oven is steam-heated by means of nests of internal pipes, and a constant vacuum is maintained in the oven, which is 16ft. in diameter, and some 18ft. long, and as the illustration, Fig. 4, shows, the alternators are run into the oven on bogies mounted on rails. In some cases alternator windings are completely immersed in varnish when in the heater, and a large tank is provided for that purpose. During the present year a new pattern shop has been put into use, in which the largest patterns necessary in the construction of turbo-generator sets can be made. The old pattern shop has been re-conditioned and equipped for the preparation of insulating materials. The stranded conductors for the stators of alternators are also built up in this shop and encased in insulating troughs by special machines evolved at the Heaton works.

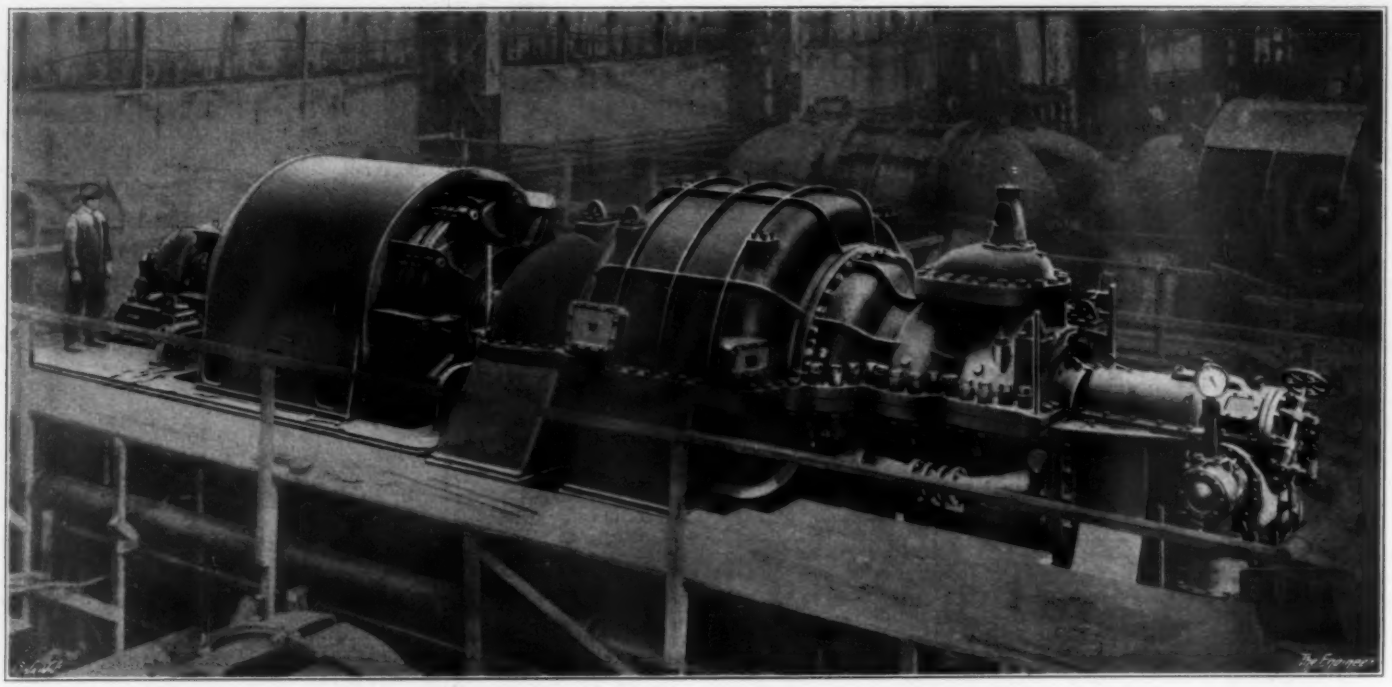


FIG. 1—12,000 KILOWATT SINGLE-CYLINDER PARSONS TURBO-ALTERNATOR

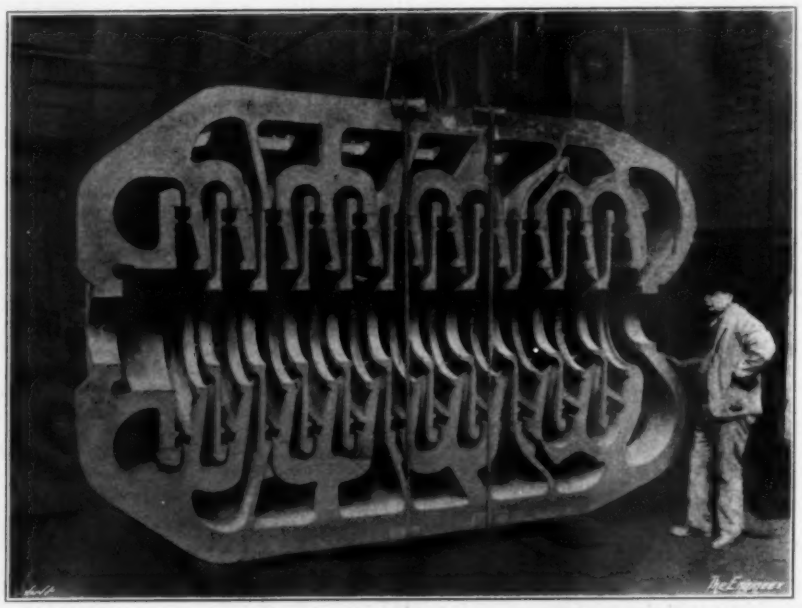


FIG. 2—CAST IRON CASING FOR PARSONS TURBO-AIR COMPRESSOR

The Reyrolle works were described in THE ENGINEER of January 12th, 1923. At present the factory provides employment for no fewer than 2000 work-people, and it is claimed to be the largest factory in the world devoted solely to the manufacture of switchgear. In the year 1922 the works occupied 150,000 square feet of floor space, and stood on a site of 5½ acres, but at that date it was decided to make use of an additional site of 4½ acres which the com-

INSTITUTION OF ELECTRICAL ENGINEERS—SUMMER MEETING VISITS

FIG. 3—TESTING AND BALANCING HOUSE AT HEATON WORKS

FIG. 4—LARGE VACUUM DRYING OVEN AT HEATON WORKS

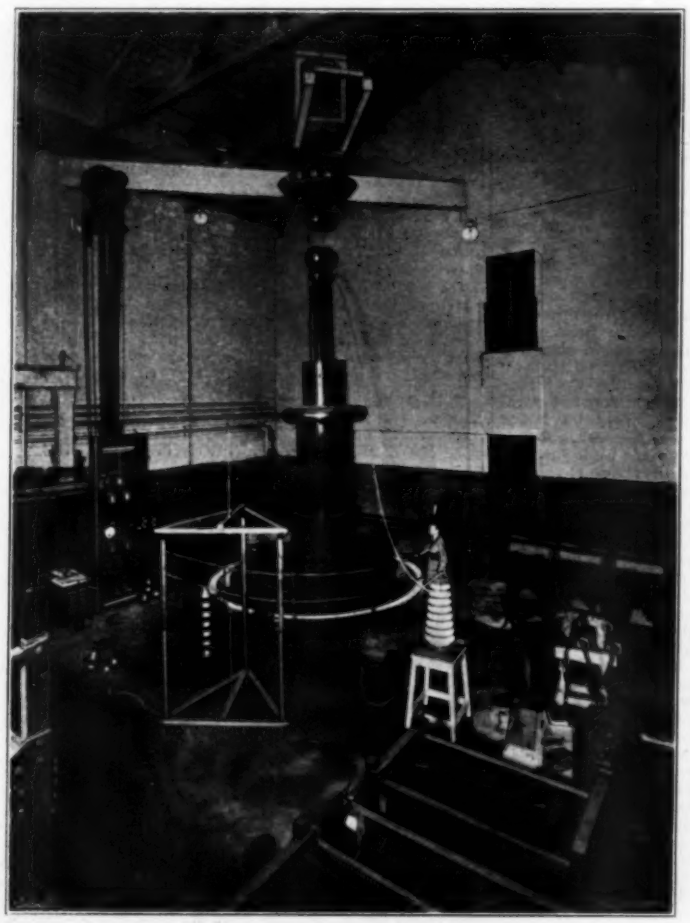


FIG. 5—EXTRA-HIGH-PRESSURE TEST ROOM AT HEBBURN WORKS

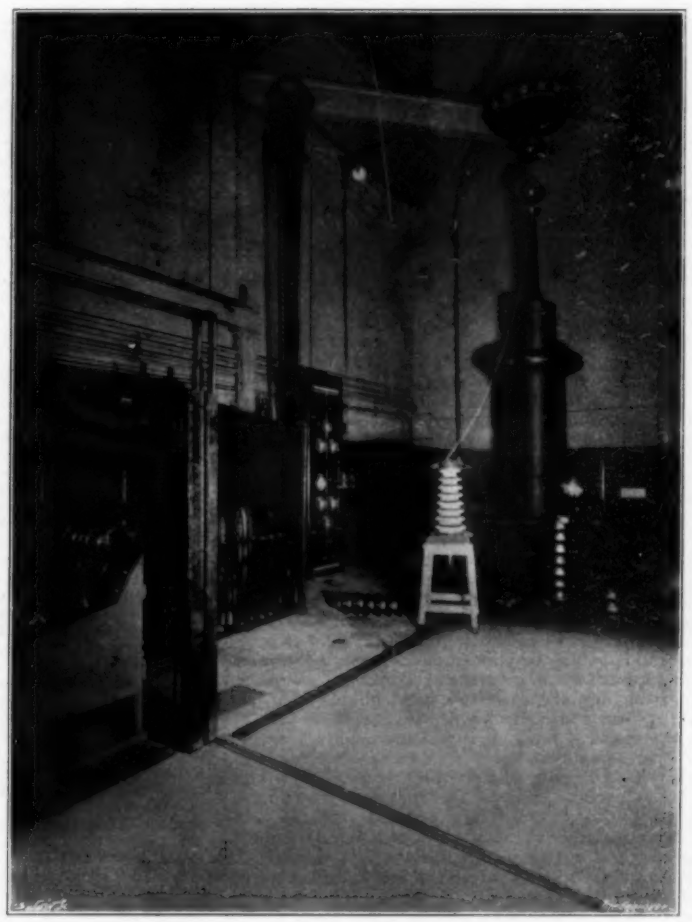


FIG. 6—TESTING TRANSFORMER AND CONTROL GALLERY AT HEBBURN WORKS

pany already possessed, and to modernise the factory on the original site. The new factory comprises nine bays, with a total area of 72,000 square feet, and ample space is available on the new site for extension to 200,000 square feet. In 1922 the switchgear output of the old works had reached 140,000 kW per annum, but the present works is capable of an output of 210,000 kW per annum. One of the most interesting sections of the factory, with which we have not hitherto dealt, is the testing and research laboratory. Figs. 5 and 6 show the extra high-tension test room, which is equipped with a 500,000-volt oil-insulated testing transformer, which is placed in a pit 14ft. in diameter and 11ft. deep.

On the terminal bushing there is a limiting resistance, which is surmounted by a 500 mm. sphere. Above this sphere there is another sphere, which is earthed, and the length of the gap between the two spheres can be altered by remote electrical control gear, the length of the gap, which can be as much as 14in., being indicated on the disc to be seen above the upper sphere. This disc is about 5ft. in diameter, and its bevelled edge is divided into lengths, representing inches and eighths of an inch. Connection is made to the transformer sphere by means of a substantial flexible connector, which is easily connected to the particular piece of apparatus it is desired to test. In order to minimise corona effects, the diameter of the flexible connector is as large. The height of the transformer to the top of its sphere is 33ft. 9in., whilst the terminal is 16ft. long. Including the weight of the oil, the total weight of the transformer is 57 tons, the quantity of oil used being 6000 gallons.

The transformer is controlled by means of a variable frequency motor generator and auxiliary transformer, which make it possible to vary the primary pressure between zero and 11,000 volts, the regulating apparatus being worked through gearing from a motor, which is controlled from the gangway surrounding the testing space in the centre of the laboratory. In the foreground of Fig. 5 a Petersen needle gap is to be seen, and to the left of this there is a demonstration board for showing the operation of the two-core pilot feeder protection scheme, whilst on the right of the large transformer there is a pole-mounting cable terminal sealing bell connected up, ready to undergo a pressure test. On the extreme right at the back is a set of three single-phase heavy current transformers, capable of giving up to 30,000 ampères for heat tests and protective gear stability tests, whilst in the foreground there are two 30,000-volt glass plate condensers for use in researches on high-frequency discharges.

In order to provide sufficient electrical clearances, it was necessary to make the test room 29ft. high, and for the same reason it was essential to design the room with as few obstructions as possible. In order that the room may be darkened whenever it is desired to observe corona effects and discharges of other kinds, the room is illuminated entirely by artificial light. An expanded metal gangway with an expanded metal roof is extended completely round the test room, and the observers stand in this gangway and operate the control gear, as shown in Fig. 7. As the metal of the gangway is thoroughly earthed, the operators are completely protected from danger. Part of this gangway and control board are to be seen in Fig. 6, where the main transformer is shown connected to an 88,000-volt insulator. On the left of the transformer in this illustration a supplementary cage for testing up to 100,000 volts is shown. A sliding window, fitted with wood instead of glass, in the further wall of the laboratory serves for observation from a room on an adjoining upper floor.

Naturally, the earthing connections have been very carefully designed. Two copper rings surround the outside of the transformer pit wall and connections are brought to each of these rings from special earth bars, which are run across the laboratory floor into which they are sunk. A connection is also made to a bar, which runs up the wall to the earthed side of the main sphere gap above the transformer, and additional bars are brought through the pit and securely bolted to the side of the transformer tank. On the adjoining upper floor previously mentioned there is an instrument room, and adjacent to this there is a laboratory for research work on small articles and a department for carrying out chemical tests and photographic work. The whole of the equipment was designed by the firm's engineers for routine and experimental testing in connection with the various types of switchgear made at these extensive works.

FIG. 7—CONTROL GALLERY FOR H.T. TESTING LABORATORY AT HEBBURN WORKS

In the evening there was a civic reception at the Grand Assembly Rooms, Barras Bridge, by the Rt. Hon. the Lord Mayor of Newcastle-upon-Tyne (Councillor A. W. Lambert) and the Lady Mayoress.

(To be continued).

SIXTY YEARS AGO.

IN 1865 the War Office desired to institute a competition for rifled small arms. The response was so poor that the Department was compelled to return the few entries submitted and to abandon the proposed trials. The reason for the apparent indifference of manufacturers and inventors to the competition was not far to seek. There was a complete distrust of the Government and the manner in which it would treat the competitors and their weapons. That distrust was apparently justified by experience. In the case of a competition for heavy guns the Ordnance Select Committee had carried out lengthy tests and had practically condemned every pattern submitted to it. It then proceeded to take the best points of each weapon and to combine them in a gun—the Woolwich gun—which it claimed as its own weapon and patented. This treatment proved discouraging to inventors, as well it might, and explained the failure of the 1865 competition. Then came the war between Prussia and Austria and the triumph of the Prussian needle gun. All the nations of Europe hastily began to seek a satisfactory design of breech-loading rifle. In this country the Snider system of converting the existing muzzle-loaders to breech-loaders was adopted as a temporary expedient, but it was recognised that something further was required. A new competition was advertised. It was made clear that the Ordnance Select Committee would not be allowed to patent any design of its own, and together with other rules and regulations this assurance seems to have restored the confidence of inventors in the integrity of the Government. From our issue of June 14th, 1867, we learn that eighty-three different kinds of breech-loading rifles had up to that date been tested. Some of them, it was suggested, required great courage on the part of the judges to discharge. The rapidity of fire of the more promising designs was tested by determining the time taken with them to fire twelve shots. Some of the names and times may be of interest. Henry's rifle required 49 sec. for the twelve rounds, the Remington with central-fire cartridges 50 sec., the Snider—four designs were submitted by this company—from 1 min. 7 sec. to 2 min. 3 sec., and the Martini, a Swiss gun, stated to have a good accuracy, 48 sec. Other rifles which attracted attention were the Albini and Braendlin, the Fosbery, Peabody, Berdan, and the Joslyn. Several of the breech-loaders made use of cartridges which were intended to be wholly consumed in the barrel, the object being to eliminate the ejection of the empty case. These rifles do not appear to have given satisfaction. The paper or fabric composing the case of the cartridge was not entirely consumed and the residual fragments either impeded the action of the breech mechanism or adhered to the firing gear and had to be removed by hand.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"HOWLERS."

SIR,—Examination candidates sometimes give answers to their torturers which are too delightful to be allowed to be forgotten. I have just come across a number; these were given by candidates who sat for the old Board of Education "Science and Art" Examinations some twenty years ago. The subject was "Heat Engines," the Chief Examiner was that very wonderful teacher, John Perry, and I assisted him in the correction of many thousands of such papers spread over a period of some ten years. At the beginning of the period the subject was briefly termed "Steam," and even when its title was expanded the majority of the questions still related to the steam engine.

The properties of steam itself and the way in which it did work in the cylinder must have seemed very complicated to some candidates. One of them considered that "A steam jacket is used to keep the cylinder walls perfectly cool, or rather as cool as possible. Condensation occurs because cylinder walls become too hot." Another modestly addresses the Examiner: "Dear Sir, the limit of usefulness of expansion I have not heard much of, so have not attempted." Another, considering himself better informed, remarks: "The usefulness of expansion is prevented by water flowing through the cylinder walls so as to keep them cool." Jacketing and its service to the engine often proved puzzling; this puzzle was tackled by one candidate thus: "The presence of water tends to lower the temperature of the incoming steam and sets up a condition which is sometimes termed jacketing;" whilst according to another, "There is no limit to the expansion of steam because the more we expand the more superheat we get and the steam becomes much drier." A truly ingenious arrangement of the engine was described thus: "We have a condenser for the steam to pass into straight from the boiler instead of the engine. It then comes out of the condenser to engine called dry steam."

The measurement of horse-power was usually a familiar matter, and one candidate of a strictly logical frame of mind answered a rather loosely phrased question to the effect that "I do not know how you would find the horse-power of the engine with only the boiler pressure given;" another used "A friction Dynamiter;" whilst another candidate confessed "The rest is simple calculation from the procured data, but as I have forgotten all formulæ bearing upon this subject, I can go no further!" In a motor vehicle horse-power can be used, as we all know nowadays, to produce an inconveniently high speed of travel, but in the more law-abiding days of twenty years ago it was possible to state that "The speed of the horse-drawn vehicle is limited by the strength of the horse, but the speed of the motor is only limited by Act of Parliament."

The production of steam in the boiler was sometimes peculiarly baffling. One candidate thought he had the truth of the matter when he expressed the view that "If there is a limited supply of oxygen most of it is wasted in forming water with the hydrocarbons." Another, faced with a question dealing with a boiler furnace fire of "about 12in. thick" evidently felt bound to point out that "If a firer fires up his furnace fires 12in. thick you can rely upon it there is going to be bother somewhere." Yet another, faced with the necessity to describe an experiment he had done or seen done to determine the calorific value of coal by a calorimeter measurement, got to what had evidently been a critical point in the experiment, and added "Further than this I can remember nothing distinctly."

Sir Charles Parsons may not be flattered at the following description of his steam turbine just twenty years ago: "The turbine is placed in a box so that when the blades fly off they can easily be found." And he may be surprised to learn that "The cylinder and piston-rod of a turbine engine is one of the most prominent things that take part in driving a steam engine." On the other hand, great things were done in those days, for "The fly-wheel rim is generally made heavier than the wheel itself." One cautious candidate agreed that "a flexible shaft is therefore necessary, but as this is the patent of the inventor, it is impossible to describe it."

Sometimes John Perry was fairly caught. He asked one year "If you had a good many examples like this to work out, how would you arrange the work so as to have no unnecessary arithmetic?" The answer came at once: "I would do it on the slide rule and so have no arithmetic at all."

The old "Science and Art" Examinations served a very useful purpose in their day. We are assured that the need for such examinations has long since disappeared. I hope the educational experts are right, but the evidence on which they acted has not come my way and I cannot judge. Sentimentally, one cannot but regret the change. H. E. WIMPERIS.

London, June 11th.

HIGH-PRESSURE RECIPROCATING ENGINES.

SIR,—We have been hearing a good deal of late about the use of steam at extra high pressure, and in this connection generally think of a steam turbine, but a reciprocating engine should be much more efficient, especially for the lower powers and when exhausting against a considerable back pressure.

I should be glad to know what is the highest steam pressure and steam temperature which is being successfully used under every-day conditions of continuous operation in a reciprocating engine of any size, say, not less than 100 H.P., and where a description of such engine can be found?

June 14th. M.I. MECH. E.

"LAST BEAM ENGINE."

SIR,—Messrs. Petrie and Co., Ltd., of Rochdale, made a Beam engine about 1902 for the Rossendale District, the sizes being as follows:—High-pressure cylinder, 33in. diameter by 3ft. stroke; intermediate pressure cylinder, 50in. diameter by 3ft. stroke; two low-pressure cylinders, 42in. diameter by 6ft. stroke; boiler pressure, 160 lb.

This four-cylinder triple-expansion engine was designed for a load of 1150 indicated horse-power when running at 39 revolutions per minute. The high-pressure cylinder was fitted with Corliss valves, and the intermediate and low-pressure cylinders with piston valves. Possibly there are Beam engines running that were built after this date. H. TAYLOR.

Rochdale, June 14th.

Railway Matters.

THE London and North-Eastern Railway has issued an official statement that the timing of the East Coast Scottish trains will practically be the same this summer as in former years—in other words, there is to be no race to the North.

WHAT is claimed to be the most powerful mine haulage locomotive in the world has been recently delivered to the Bertha Mine, Pa., U.S.A. It has two motors, each capable of developing 150 H.P., and will start and haul a 400-train on a level track. The gauge is 42in., the wheel base 80in., and the length, excluding bumper block, 17ft. 4in. It is a Baldwin-Westinghouse production.

THE question of the mails to and from Belfast was mentioned in this column on April 29th. It was raised again in the House of Commons the other day, when the Postmaster-General said that with dispatch *viâ* the Kingstown-Holyhead route letters were delivered in Belfast twenty-five minutes earlier than was possible if sent by Stranraer, whilst letters in London were two hours earlier. There had been no material alteration in Post Office expenditure.

FOR the twenty-two weeks ended June 5th the London, Midland and Scottish had an increase in its goods receipts of £1,070,000 over the corresponding period of 1925—the period now used instead of 1926 for comparative purposes—the London and North-Eastern £1,389,000, the Great Western £850,000, and the Southern £63,000. Each company, though, has a falling off in passenger traffic, but, except the Southern, the total receipts have advanced.

THE Buffalo and Fort Erie and Peace Bridge, which spans the Niagara River and links the United States and Canada, was opened for traffic on June 1st. Work on the bridge was started in August, 1925. The span is 4200ft. in length, the width 36ft. and the cost 4,500,000 dollars. The official opening will take place late in September, when it is proposed that the Prince of Wales and President Coolidge shall meet mid-bridge and exchange greetings between the two countries.

WITH the change from narrow to standard gauge on the southern line of the Egyptian Government Railways, from Luxor to Shellal, 135 miles, the entire system of 2050 miles is now standard gauge and the scheduled time from Cairo to Shellal, 550 miles, has been reduced by four hours. The Luxor-Shellal line was built originally as a military railway of 3½ft. gauge. The new work includes strengthening the bridges and reballasting the tracks. All this work was done in about ten months and without interrupting the traffic on the narrow-gauge line.

THE London correspondent of the *Manchester Guardian* recently stated that he understood that, as a result of the recommendations of the London and Home Counties Advisory Committee, a pooling agreement has been reached between the Underground Railways, the London General Omnibus Company, and the London County Council, which is responsible for the tramways, as a result of which wasteful competition would be eliminated and the receipts would go into a common pool to be subsequently divided according to the earnings of the respective companies.

THERE is a probability that, after all, the aerial ropeway from the Tilmanstone Colliery to Dover, the refusal of which by the Railway and Canal Commission was mentioned in this column of our issue of March 25th, may receive more fortunate treatment. One of the causes for rejection was that the scheme was submitted in an incomplete state. It is now explained that the plans were those of a contractor, but a consulting engineer has since been called in and a perfected scheme prepared. The Railway and Canal Commission has, therefore, agreed that a renewed application may be heard on Monday, July 25th.

AN all-steel restaurant car has been built by the Victorian Government Railways. At a dinner to some of the leading Melbourne citizens in celebration of the first use of the new car, Mr. H. W. Clapp, the chairman of the Railway Commissioners, said that they were at that time building the biggest passenger locomotive, the largest freight locomotive, and the biggest mountain locomotive, to be constructed in Australia. Australian material was, as far as possible, being used throughout, but it had been necessary to import some steel castings, as Australian-made castings had not been successful, though it was hoped that in time that difficulty would be overcome.

A NUMBER of high power locomotives, known as the "Mountain" type, have been constructed by the Compania Euskalduna, a purely Spanish concern. General Mayandia, speaking at a banquet held after a trip on one of these locomotives, which covered a stretch of some 30 miles at the rate of 55 miles an hour, said: "The engine ran so perfectly that Spain may to-day claim to possess an industry capable of competing with the foremost constructors of other countries." After the banquet, the General visited the works of the Babcock and Wilcox's Spanish company, which has undoubtedly contributed largely to the progress made by Spain in the engineering domain.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first four months of the present year was as follows, the corresponding figures for 1926 and 1925 being added in brackets:—Locomotives, £471,316 (£1,407,367, £1,195,610); rails, £601,407 (£770,180, £612,775); carriages, £886,173 (£801,426, £542,222); wagons, £648,259 (£1,243,356, £1,075,094); wheels and axles, £140,946 (£179,515, £218,606); tires and axles, £132,963 (£105,530, £152,256); chairs and metal sleepers, £234,139 (£355,826, £248,425); miscellaneous permanent way, £448,623 (£436,097, £486,874); total permanent way, £1,657,390 (£1,945,357, £1,765,822). The weight of the rails exported was 70,381 tons (98,267 tons, 63,239 tons), and of the chairs and metal sleepers 24,834 tons (36,268 tons, 20,453 tons). During April last alone the value of the locomotives shipped was £197,007, of which other countries in South America than the Argentine took £21,198 and the Argentine £18,763. India had £9696 and certain unspecified "other countries" £143,590. The value of the rails shipped in April was £242,220 and included Australia, £31,762; India, £31,359; Portuguese East Africa, £12,988; the Argentine, £10,123; New Zealand, £8593; and South Africa, £7002.

Notes and Memoranda.

A PROPOSAL is on foot to establish a new beet sugar factory in Bedfordshire.

IT is announced by the British Broadcasting Corporation that it proposes to adopt forthwith the principle of stating the kilocycle or frequency figures for all its stations instead of the wave length now given in metres. Thus London, with a wave length of 361·4 m., has a kilocycle figure of 830. Under the Geneva scheme of the Union Internationale de Radiophone, the spacing between the exclusive wave of a station and the common waves of several stations should be maintained at a frequency of 10 kilocycles, which difference, if kept constant, will avoid interference between stations.

RECENT experiments on heat treatment of steel, which have been made by C. W. Bryan, the chief engineer, and C. G. E. Larson, the assistant chief engineer of the American Bridge Company, have, it is claimed, resulted in the production of a steel having an elastic limit of between 75,000 lb. and 100,000 lb. per square inch. With this high elastic limit it will be permissible to increase the unit working stress from 16,000 lb. to 50,000 lb. per square inch, thereby requiring, it is stated, less than one-third as much steel as would be necessary with the use of the ordinary 30,000 lb. per square inch elastic limit steel.

THERE has recently been installed in the A.E.G. transformer works in Berlin, says the *Electrical World*, a plant for the regeneration of transformer and switch oils in which the oil is not only treated with china clay or similar substances, but undergoes a regular refining process; that is, the oils are treated with similar materials to those used in refining new oil. Transformer or switch oil that has become useless, acid, or black, is by the regenerative process rendered utilisable, of high value, light in colour, and with properties which do not differ substantially from those of completely new oil. The regenerating costs are fixed, so that, taking into account the scrap value, the wear and tear, and the cost of transport, a definite saving, it is claimed, is obtained.

WIRELESS problems were discussed at the recent Colonial Conference held in London. The opinion was expressed that progress in the application of wireless-telegraphy was so rapid that the formulation of a definite general scheme for the Colonies would be premature. It was pointed out that the amount of work in the Colonies and Protectorates had not been very extensive. During the past fifteen years about thirty small stations had been erected, and were utilised mainly for local requirements and communication with shipping, but they were regarded as the preliminary links in a chain of inter-Imperial communication which might ultimately be established. The adoption of a short-wave service between Singapore, Penang, and neighbouring States is contemplated by the Straits Settlements Government, and Kenya looks forward to being in a position to pick up short-wave transmissions from this country.

IN the course of an article on the use of rubber in industrial operations, reference is made by the *South African Mining and Engineering Journal* to rubber liners used experimentally in tube mills. The type of liner used was a vulcanised rubber product, named "Linerite," manufactured by the B. F. Goodrich Company. The rubber liner was first substituted for a hard iron or manganese steel liner and consisted of a slab of rubber, 3ft. wide, 12ft. 9in. long and ¾in. thick, fitted into a 20ft. by 4ft. diameter tube mill with 1¼in. iron balls. After three months' continuous operation the loss of weight of the rubber was so small that a complete liner was employed for a similar mill, using 20 tons of 1¼in. iron balls for grinding. Six months later the liner was in excellent condition, and it was proved that the liner itself played only a small part in the grinding, its chief function being to protect the shell of the mill. Later experiments with an improved rubber liner gave a loss due to wear of less than 1·5 per cent. during three months' operation.

NATURAL graphite is used chiefly in the manufacture of foundry facings, pigments and paints, crucibles, pencils and crayons, and commutator brushes. As the result of an investigation by the United States Tariff Commission, it was found that, contrary to general opinion, the use of graphite in the manufacture of crucibles is comparatively small. Only 15 per cent. of the consumption for finished products went to this use in 1923 and 13 per cent. in 1924. Foundry facings consumed the largest proportion—44 per cent. in 1923 and 52 per cent. in 1924. Pigments and paints were second in the quantity of graphite consumed—16 per cent. in 1923 and 18 per cent. in 1924. The manufacturers of pencils and crayons and of commutator brushes ranked fourth and fifth as consumers of graphite, each taking 9 per cent. in 1923 and 5 per cent. in 1924. These five products used 91 per cent. of the total in 1923 and 93 per cent. of it in 1924. Only three uses, all minor, showed increases in 1924 as compared with 1923. Graphite for bearings and bushings and for lubricants commands the highest prices.

THE transmission losses in the compressed air system, states Dr. Gaertner in a paper on "Colliery Power Schemes," are given by Haack as 25 per cent., by Schweinitz as below 15 per cent., and by British technical writers as, roughly, 15 per cent. Electric transmission involves losses in lines and transformers equal to about 7·5 per cent., assuming the latter to be carrying on an average 50 per cent. of their rated capacity. The efficiency of turbo-compressors of normal dimensions is about 67 per cent., so that 72 per cent. should be a liberal estimate. With an input of 1 kilowatt at the generator shaft we thus obtain only 0·15 kilowatt at the compressed-air machine shaft at the coal face, while with electrical transmission the figure is 0·71 kilowatt. Therefore with the same energy input at the power station electrical power delivers in mechanical work at the coal face nearly five times more energy than compressed air. However, the convenience, robustness and immunity from the risks of firedamp ignition, its superiority for percussion tools and the cooling action of the exhausts, have led to the almost exclusive use of compressed-air in underground mining in Westphalia, and—among other places—in South Wales.

Miscellanea.

A RICH deposit of platinum has been discovered in the Rouyn mining field, Quebec. The extent of the deposit is unknown.

THE construction of a roadway over the Quebec Bridge will be begun shortly, and will be completed for traffic, it is expected, early next summer.

MORE than 3000 street telephone kiosks have been erected in various parts of the country, and that number is being added to at the rate of one a day.

ON June 10th King Alfonso signed a decree opening a credit for 600,000,000 pesetas—about £21,400,000 at the present rate of exchange—for harbour works in Spain.

AT a recent review of aircraft at the Getafe Aerodrome, near Madrid, 120 different types of aircraft which had been either built or assembled in Spain during last year were shown.

WIRELESS communication has been established between the Cumbrae and Toward lighthouses on the Clyde, with a view to facilitating the reporting of shipping and the giving of directions in foggy weather.

THE Burmah Oil Company, Ltd., has announced its intention of presenting £100,000 to the University of Rangoon to establish a College of Mining and Engineering in connection with the University.

IT is expected that six months will elapse before a report on the double-decker bridge at Charing Cross can be presented by the committee of expert engineers, which is now engaged in examining that project.

IN the course of refining nickel-copper matte from the nickel mines of Ontario, 9471 oz. of platinum and 9780 oz. of palladium were recovered during 1926, both metals showing a considerable increase over any previous year.

ON Sunday last, June 12th, the centenary of the invention of the reaping machine was celebrated at Carmyllie, in Forfarshire. The inventor was Rev. Dr. Patrick Bell, who was minister of that parish from 1843 until his death in 1869.

ON June 8th the Crown Prince Umberto of Italy inaugurated the great hydro-electric power station at Mese, which, it is estimated, will develop 700,000,000 kilowatt-hours per annum. The plant is entirely of Italian manufacture.

THE Liége-Antwerp Canal Commission has adopted a proposal for a direct canal in Belgian territory from the Meuse to Antwerp, and it is suggested that, if the State is not able to provide the necessary resources, a private organisation should undertake the work with the support of local public bodies.

AT the new Upton Colliery, near Doncaster, the Barnsley seam has been reached at a depth of 711 yards. The thickness of the seam is 9ft. 6in., and there is reported to be only a few inches of dirt in it. When fully developed, the colliery will be one of the largest in Yorkshire, winding about 36,000 tons of coal weekly.

IT is announced by the General Electric Company of America that an aeroplane engine supercharger of its manufacture has been submitted to Government tests in military machines. For use with it a new type engine, utilising air cooling and equipped with radial cylinders with the supercharger built in, has been designed.

IT is proposed to establish a pulp and paper mill plant, with a designed output of 1000 tons per day, near the Campbell River on the east coast of Vancouver Island, hydraulic power being derived from the Campbell River Falls. The project is being undertaken by the American-Crown Williamette Corporation of San Francisco.

AN International Foundry Exhibition is to be organised in Paris in September by the Syndicat General des Fondeurs de France. Three main groups will deal with raw materials, manufactured products, and foundry materials and tools will be arranged, and other sections will deal with technical education and organisation within the foundry trade.

ADDITIONAL repairing accommodation is to be provided at the port of Fleetwood for trawling vessels. A triple berth is to be constructed adjoining the West Jetty at the main Wyre Dock entrance, and electrically operated haulage and traversing gears are to be fitted to the new slipways. Trawlers up to 550 and 600 tons slipping weight are to be accommodated, and the work is to be finished towards the end of the year.

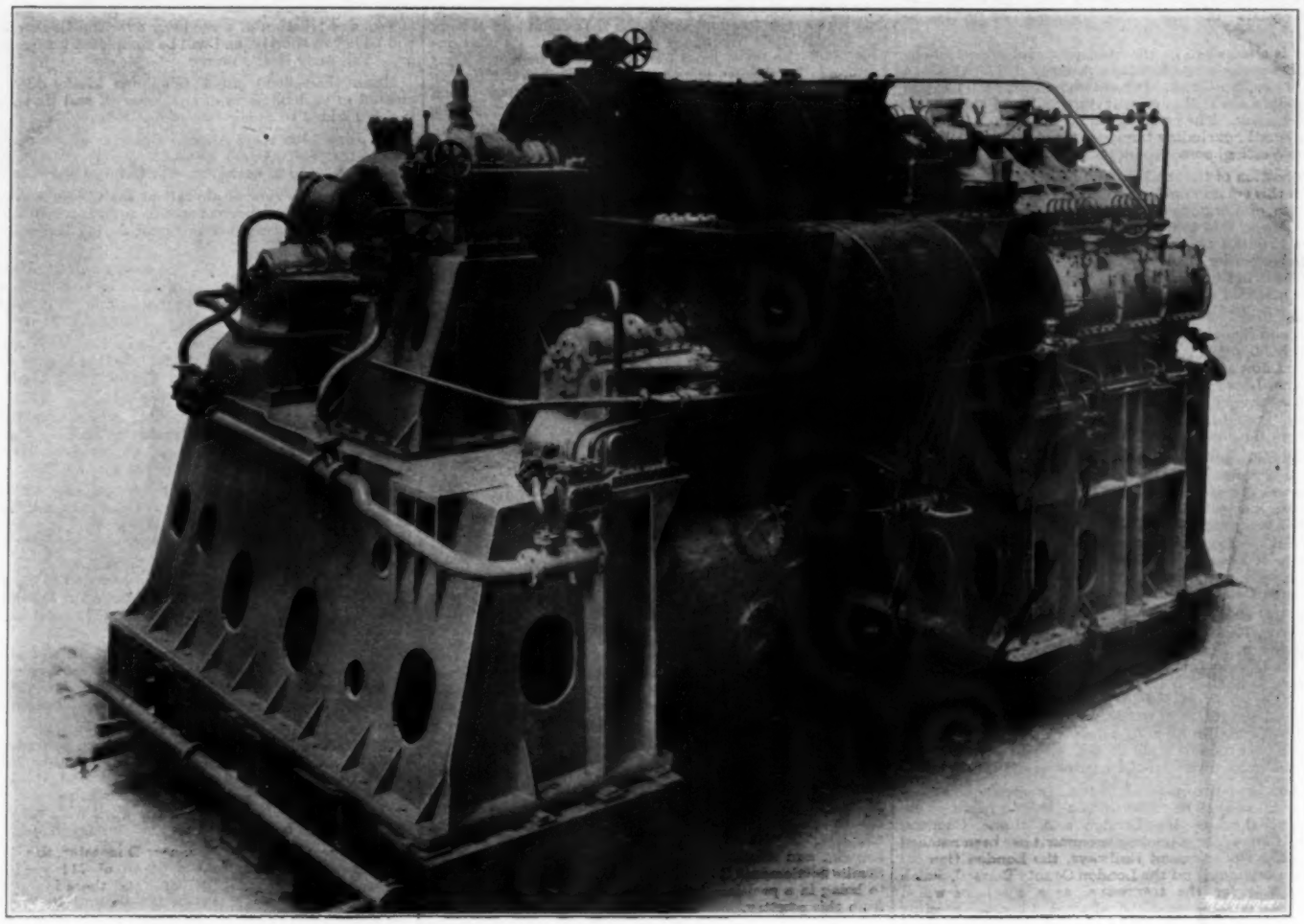
THE Sun Life Assurance Company of Canada, of Montreal, has begun the work of extending its present building, which, when completed, will, it is claimed, be the largest structure in the British Empire. It will be continued upward to the twenty-fourth storey, at a height of 450ft. The lower portion of the building will have a frontage of 400ft. on Dominion-square and a floor area of 1,250,000ft. The entire building will be erected on a structural steel frame, and the exterior will be faced with granite.

THE Swedish papers give a description of a new type of household refrigerator, called the Polzonia, which has been placed on the market by the engineering firm Bror Paulsson and Co., of Malmoe. The invention has, it is said, been tested for a year, and negotiations for its exploitation on a large scale are going on with American, European and Swedish firms. Among the advantages claimed for this refrigerator are the independence of the movable parts, such as valves and pumps, small running costs—about 10 œre for twenty-four hours in Sweden—and low price.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in blast at the end of May was 184, a net decrease of five since the beginning of the month. The production of pig iron in May amounted to 720,100 tons, compared with 680,000 tons in April and 88,800 tons in May, 1926—the first month of the coal stoppage. The production includes 256,500 tons of hematite, 222,200 tons of basic, 184,200 tons of foundry and 24,100 of forge pig iron. The production of steel ingots and castings in May amounted to 882,500 tons, compared with 850,100 tons in April and 45,700 tons in May, 1926.

NEW PROPELLING MACHINERY OF THE CANADIAN-PACIFIC LINER EMPRESS OF AUSTRALIA

(*For description see page 649*)



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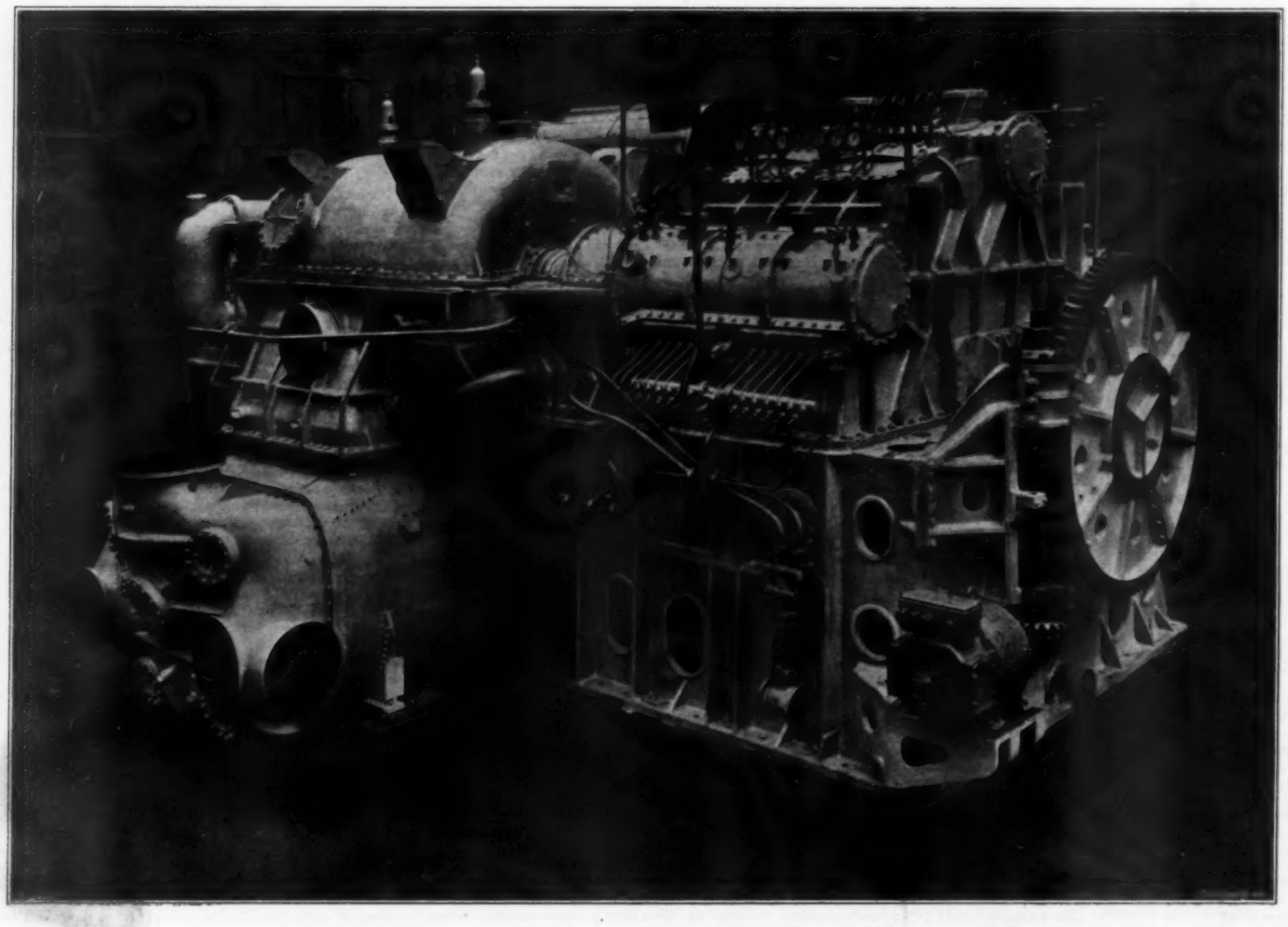

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DEATH.

On June 9th, 1927, at Castle, Wiveliscombe, Somerset, CHARLES ARTHUR LOVEGROVE, A.M. Inst. C.E., formerly deputy director of Public Works, Ceylon, aged sixty-nine.

On June 14th, 1927, at 7, Bute-mansions, Glasgow, PETER MACLEOD BAXTER, M.I.N.A., M.I. Mech. E. (formerly of Messrs. McKie and Baxter, Engineers, Govan), aged sixty-two.

THE ENGINEER.

JUNE 17, 1927.

French Air Services.

AMONGST the many airway schemes which it is proposed to carry out in France, the most prominent at the moment is an extension to South America of the existing line from Toulouse to Dakar, on the west coast of Africa. In referring to the scheme recently we stated that a programme of air lines was being drawn up which would make Bordeaux a great aviation centre, as a result, in part, of an extension of the Toulouse–Dakar line. The President of the Région Economique de Bordeaux et du Sud-Ouest has since declared that the connection of Bordeaux with Africa will be made independently of the Toulouse service, and that the proposed line will go by way of Lisbon to North Africa, where it will join the Toulouse–Casablanca–Dakar airway, with, eventually, a continuation to South America. The proposed South American service will therefore have termini at Bordeaux and Toulouse. Future air service developments are, however, at present passing through a preliminary stage of investigation. There has been until now a lack of cohesion, and enterprise has been left in the hands of a number of companies working independently of each other. The number of these companies has now been reduced to four or five, and a serious effort is being made to reorganise the whole system of commercial aviation so as to secure to France a fair share of the international traffic. The several international lines already in existence have necessarily to employ airways used by foreign companies, and, while developing these routes, it is hoped to extend them in fresh directions, and also to create entirely new services. These developments will be mainly towards the Atlantic, along the Mediterranean to the east and between French West Africa and South America. Its geographical situation obviously gives France certain advantages, particularly in providing for overseas traffic, and it is significant that the machines from Berlin will have to pass over France to reach Seville, whence the German-Spanish airships and seaplanes will proceed direct to Buenos Aires. There is still some possibility of friction in this connection, for the German-Spanish group affects to believe that the contract which has been secured by a French company for the transport of mails to and from Argentina is an exclusive one, and in that case, it is declared, an attempt will be made to prevent the French machines for South America from flying over Spanish territory. The inauguration of the French service across the South Atlantic, however, is likely to be delayed considerably by the tragic failure of Captain de Saint-Roman, as well as by the disappearance of Captains Nungesser and Coli. Such disastrous experiments cannot be repeated without compromising for a long time to come the success of future transoceanic services. Despite their anxiety to get ahead of Germany, the French are not likely to do anything until they are sure of the safe organisation of the South Atlantic airway.

Since the formation of the Propaganda Committee, which aims particularly at creating home lines which will serve as feeders for the international airways and which will at the same time develop the spirit of air travel amongst the French, there has been considerable rivalry amongst the various industrial regions to become centres of air transport activity. At a recent meeting at Lille of representatives from all the northern departments, it was decided to recommend the creation of the following airways:—Alsace–Lille–England; Belgium–Lille–Rouen–Le Havre and beyond; Lille–Paris and beyond; Lille–Douai–Cambrai–Saint-Quentin–Rheims–Troyes; and also connections with the maritime services at Boulogne, Amsterdam and Hamburg. These proposals show a remarkable spirit of commercial aviation enterprise, as the result mainly of carefully organised propaganda, but it would seem that this enterprise has already exceeded the possibilities of practical realisation. So far as the national or feeder lines are concerned, the chances of establishing more than a very small proportion of the schemes appear remote. Feeder lines must pay their way or rely upon local subsidies which would soon be found too onerous to be continued, and from whatever standpoint the future of feeder lines is considered it is obvious that, for comparatively short distances, they will be unable to compete with railways and motor cars. Wherever these facilities are available, the aeroplane will not offer any advantage for the transport of parcels or mails. It is true that local services have been largely developed in Germany, but they have not been profitable, and are not in many cases really useful, but they have served a valuable purpose in developing national aviation and enabling the aeronautical industry to improve its facilities for organising and equipping international lines. In France the conditions are much less favourable for the creation of local services, and although schemes have been put forward for connecting up different industrial centres all over the country, it is doubtful whether anything really practical will be done. The idea behind the institution of these services was mainly to provide aeroplane builders with a market for their machines and to increase their manufacturing facilities, but expert opinion disapproves of the propaganda on the ground that a system of short-distance airways, offering little or no advantage from the point of view of transport, would inevitably fail and might cause considerable harm to commercial aviation generally. Therefore, if industrial centres are to benefit from aviation it can only be in association with long-distance services, preferably by the creation of international airways which will cross France in all directions. This is the guiding principle in the various schemes now being put forward.

If these schemes are to be carried out it obviously follows that something must be done to develop machines for the special services for which they are intended. In France builders depend almost entirely upon the requirements of the military authorities, both at home and abroad, and they can only survive with the aid of what practically amounts to the payment of State bounties. Makers have practically no opportunity of developing types of machines that do not fall within military classifications. All the commercial aeroplanes now in use are more or less developments of bombing machines. They have not been designed primarily for commercial purposes which require the attainment of certain standards of security and economy. In the opinion of one of the leading French experts an aeroplane cannot compete with the railway unless it can travel at nearly three times the speed of a train, and has a range of at least 600 miles and, in addition, can fly at night with a paying load. Speed is also essential for crossing the Mediterranean, over which for a great part of the year the wind is usually very high. The French technical services know exactly what is required, both for commercial aeroplanes and seaplanes, but the lack of financial aid has hindered

progress in the construction of purely commercial machines, which, however, must be built if the various air services now projected are to be definitely established.

International Discussion.

THE problems of science and technology are world-wide. Natural laws and phenomena and the requirements of civilised man are very similar in all countries and the means available for dealing with them, both material and intellectual, are much the same. Yet, while to a considerable extent scientific and technical knowledge is disseminated throughout the world, there still remains a serious element of isolation. The fact is that knowledge obtained from books and publications often fails to carry its due weight. It is exceedingly difficult, except perhaps for a few experts, to sift the chaff from the wheat in the great mass of the world's technical literature, with the result that personal contact often carries more weight than it should. We are, inevitably, inclined to accept more readily results obtained in our own country, and by men whom we know, than those published elsewhere, perhaps in an unfamiliar language and by men scarcely known to us even by name. These factors, together with a certain degree of national self-consciousness which it is difficult to avoid, tend to produce a certain measure of isolation in the scientific and technical work of the different nations. This is most obvious in those cases where we find the work of the investigators of one country more or less ignored by those of another, at all events so far as acknowledgment is concerned. It may not perhaps matter a very great deal in the long run to what particular individual a discovery is ascribed in different countries, but it does matter very much that sound work done in one country should remain more or less unknown and unaccepted in another until the same discovery is made there, perhaps many years later. We could quote a number of instances, in connection with metallurgy and its application to engineering problems particularly, where this has happened. The disturbance of international relations from which the world has suffered since 1914 has, of course, aggravated this state of affairs, but it existed even before the upheaval, and the factors that give rise to it are still at work to-day. The best method of remedying the defects of the existing conditions lies in securing closer and better intercourse between the scientific and technical workers of the different nations. Two of our great metallurgical institutes —the Iron and Steel Institute and the Institute of Metals—aim at a certain measure of internationality in their membership. They are freely open to metallurgists, and those interested in metals in all countries, and in the Institute of Metals particularly, the foreign membership has been growing more rapidly of late than the British. This is all to the good from the present point of view, but it is not sufficient to meet the need for international intercourse and co-operation in metallurgical matters. The meetings of these institutes when they take place in Britain—as they most generally do—are attended by only a few of the foreign members, so that personal contact is still very limited.

A remedy for this state of affairs, in regard to metallurgy and engineering, was sought many years ago when Bauschinger and Tetmayer founded the old "International Association for Testing of Materials." This body held a series of highly successful congresses at three-year intervals, the last in New York in 1912. At first, this Association gave its attention exclusively to the discussion of the more important problems of world-wide interest, and a long series of valuable papers and reports was prepared. But the value of the work of the Association did not, perhaps, lie mainly in this mass of published papers, many of which could have found adequate publication in other ways. The congresses and committees of the Association brought into contact most of the leading workers, in all the participating countries, with the result that they not only formed personal friendships and connections, but they were spontaneously led to take more interest in and attach more weight to the work done by their colleagues—now personally known and appreciated—in other countries. Mutual understanding and knowledge gave rise to mutual respect and appreciation. The good work thus undertaken was, unhappily, brought to an end by the war, but even before that event the Association had begun to encounter difficulties. So long as the work of the Association was devoted to the discussion of technical and scientific problems, few, if any, discordant elements arose. Unfortunately, however, an effort was made to lead the activities of the Association and its congresses and committees to another field —that of international standard specifications— where conditions are essentially different. Those who are acquainted with the work of preparing and securing the adoption of national standard specifications know that it is not merely a technical problem, although the technical and scientific aspects of testing are, of course, closely involved. The business and industrial side is supremely important. This fact is so fully recognised that it is accepted as axiomatic, in this country at all events, that the full concurrence of industry must be secured before a national standard specification can be usefully put forward. On the British Engineering Standards Committees the proper representation of the industries concerned is carefully secured, as well as that of the engineer users of the materials in question, while the scientific investigators and experts serve in an advisory and, on rare occasion, in an arbitratory capacity. Even then, at times, the inevitable clash of business interests raises difficulties which can only be overcome by patience and mutual give-and-take. Where international business interests come into play, with the added difficulties of language and incomplete mutual understanding, these difficulties become much magnified. In the case of the old International Association the difficulty was rendered insuperable by the very constitution of that body. While men interested in materials from every point of view were invited to join the Association and to attend its congresses there was not, and there could scarcely have been, any systematic representation of the many national industries and interests concerned. Neither the congresses nor the Committees of the Association, therefore, were in any sense properly constituted to deal with problems of standardisation. Any particular gathering could be, and, in fact, frequently was, swamped by members coming either from the country where that meeting took place or from some country where a special effort to secure representation on that particular occasion had been made. Decisions arrived at, or even recommendations made in such circumstances, could carry little, if any, weight, and the discussions which arose tended to stultify the truly valuable function of the Association in fostering mutual goodwill and understanding between the technical men of the different nations.

These matters might perhaps be regarded as of merely historical interest, were it not that a suggestion for reviving the old International Association for Testing Materials has been made. A committee, consisting mainly of Dutch and Swiss technical and scientific men interested in the testing of materials, has organised an International Congress which is to be held at Amsterdam in September next, and invitations to attend have been issued throughout the world. We believe that a number of important British institutes and organisations propose to send delegates to this Congress, which promises to be an interesting and important gathering. With the holding of this Congress and with the reconstruction of an international organisation for the purpose of arranging future congresses every three or four years, we have the fullest sympathy. For the reasons outlined above, this is a movement in a much-needed direction, and we sincerely hope that British representation at Amsterdam will be adequate both numerically and in the status of those who will have to uphold British prestige at the Congress. It would be most unfortunate if British metallurgy and engineering were not to take their full and proper part in the work of the Congress. It must be remembered that foreign users of metals and other engineering materials will be fully represented at Amsterdam, and, apart from the direct advantages of personal contacts made in such circumstances, the impression of the present state of British metallurgy and engineering which is gained at Amsterdam is bound to react upon the future prestige of British products in foreign markets. On the other hand, we would strongly urge—and we believe that British technical opinion is wholly with us in this matter —that the difficult and dangerous question of international standard specifications should be specifically excluded from the work of this Congress. In taking this view we do not wish in any way to pre-judge the question of the desirability or possibility of international specifications. Opinions are much divided on this question. Our point is that such an international organisation as is best suited to the holding of congresses and the fostering of desirable international intercourse and discussion is entirely unsuited to the discussion of specifications. For the latter purpose systematic representation of the interests concerned, on a carefully arranged basis of mutual fairness, is essential. This has been achieved nationally, with marked success, by our own B.E.S.A., and an attempt to set up a similar organisation with international scope is being made. It is therefore eminently desirable that, in order to avoid friction of the kind which had begun to arise in the old Association, and in order to safeguard the future of international congresses on engineering materials, the whole question of specifications should be left to be considered and dealt with by a body, or association of bodies, specifically organised for that purpose.

Literature.

Electric Switch and Controlling Gear. By CHARLES C. GARRARD. London: Ernest Benn, Ltd. Price £3 3s.

WHILE many books have been written on switchgear, we know of no volume that contains so much up-to-date information on the subject as this third edition of Dr. Garrard's book. The rapid development that is continually taking place in this important branch of electrical engineering has caused much of the switchgear literature to become out of date, but here we have a volume which at present, at any rate, represents thoroughly modern practice, and which has been written by an engineer actively engaged in switchgear design. It is a comprehensive handbook on the design, manufacture and use of switchgear and switchboards used in central stations, factories and mines, and should appeal to users and manufacturers of switchgear alike. Since the publication of the second edition of the book considerable progress has been made in the actual standardisation of switchgear by the issue of a number of specifications by the British Engineering Standards Association, but, as the author rightly points out, the general standardisation of switch and controlling gear has made very little advance. Extra high-tension switchboards exhibit the widest variations in general design, and it is difficult at the moment to decide which type is the best. This question Dr. Garrard makes no attempt to answer, but he gives typical examples of high-tension and extra high-tension switchboards now in use, including isolated phase switchboards as employed in America. There are several chapters that are of considerable interest at the present time, such, for example, as the section dealing with outdoor switching stations, which, in scattered parts, reduce the capital expenditure. A no less important section is that dealing with apparatus for protecting electrical machinery against abnormal electrical conditions in which various classes of apparatus for this purpose are described. Considerable attention is also paid to the smaller class of switchgear, such as that used for starting and controlling direct current and alternating-current motors, and to low and medium-tension switchboards. Under this heading the author discusses many switching arrangements, including switchgear for mercury vapour rectifiers and for rotary and motor converters. Protective gear and voltage regulators also receive considerable attention. The volume shows in a very marked manner what an important problem the making and breaking of electric circuits has become, and how essential it is in these days of large power stations to employ high-tension switchgear designed on the right lines. What may happen as the result of using unsuitable switch gear for rupturing high power circuits is shown in the early part of the volume, where there is a picture of a sub-station that has been destroyed by the explosion of an oil circuit breaker.

BOOKS RECEIVED.

The Activated Sludge Process. By A. J. Martin. London: Macdonald and Evans, 8, John-street, W.C. 1. Price 30s. net.

Journal of the Royal Agricultural Society of England. Vol. 87. London: John Murray, Albemarle-street, W. Price 15s. net.

Safeguarding Workmen at Oil Derricks. By H. C. Miller. Washington: Department of Commerce, Bureau of Mines. Price 40 cents net.

Universal Directory of Railway Officials, 1927. London: The Directory Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 20s. net.

Architectural Design in Concrete. By T. P. Bennett. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 30s. net.

Directory of the Members, Subscribers and Representatives of the Birmingham Exchange, 1927. Birmingham: The Birmingham Exchange. Price 2s. 6d. net.

Annual Report of the Chamber of Shipping of the United Kingdom. London: The Chamber of Shipping of the United Kingdom, 28, St. Mary Axe, E.C. 3.

The Hope of the Workers. Second edition. By Austin Hopkinson. London: Martin Hopkinson and Co., Ltd., 14, Henrietta-street, W.C. 2. Price 2s. 6d. net.

Four-place Tables, with Forced Decimals. By F. S. Cary, M.A., and S. F. Grace, M.Sc. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 1s. net.

Obituary.

GODFRED MIDGLEY TAYLOR.

IT is with deep regret, which will be very widely shared, that we have to put on record the death of Mr. Midgley Taylor, which took place on Saturday last.

Godfred Midgley Taylor, who was the son of Mr. John Taylor, M. Inst. C.E., who was Engineer to the Lambeth and New River Waterworks Companies as well as to many other water undertakings, was born on December 16th, 1861. Midgley Taylor, to give him the shortened name by which he was universally known, received his early education at King's College School, from which he passed to King's College, where, during the years 1878–1880, he gained Entrance and Science Scholarships. While at the College he specialised in mathematics and chemistry. On leaving in 1880 he became articled to his father, whose offices at that time were at 27, Great George-street, Westminster. His articles lasted for four years, and during that period he had a varied experience in numerous works connected with water supply. The first responsible position that he held was that of Resident Engineer in charge of the construction and erection of pumping machinery, an engine-house, filter beds and other works at Surbiton and West Molesey for the Lambeth Company. When that work was completed he returned to Great George-street, to assist his father and his elder brother, Mr. E. Brough Taylor, M. Inst. C.E., and in 1884 was made a partner in the firm of John Taylor and Sons.

It is worthy of note that following up the training in chemistry which he had received at King's College, Mr. Midgley Taylor fitted up quite an extensive laboratory at the office very soon after he entered it, and there he personally made the analysis of the different samples of water with which the firm had to deal in its professional work. His knowledge of chemistry also served him well when, a little later, he turned his attention to the question of sewage disposal.

As showing the wide range of his experience during the earlier years of his career, we may say that, prior to 1887, he had, besides the work for the Lambeth Company, been engaged on the following:—Impounding reservoirs, filter beds, well sinking and pumping machinery for the Bristol Water Company; softening tanks, engines and boilers, houses and well sinking for the Colne Valley Water Company; pumping machinery, well sinking and service reservoirs for the Chatham Water Company; pumping machinery and boilers for the Rochester Corporation; pumping machinery, well sinking and heading driving for the Herne Bay Water Company; and pumping machinery and well sinking for the Enfield Urban District Council. Before that time, too, he had, in conjunction with his partners, been concerned with various drainage schemes and had acted in a consulting capacity for the following cities and towns in connection with drainage and water schemes: Glasgow, Manchester, Bristol, West Bromwich, Taunton, Shrewsbury, Stroud, Pokesdown, Ilford, Southwick and Portslade, Truro, Margam, Bridgnorth and Oswestry.

After the death of their father, Messrs. Brough and Midgley Taylor entered into partnership with the late Mr. W. Santo Crimp, an expert in matters relating to sewage disposal. The association with Mr. Santo Crimp proved to be a turning point in Midgley Taylor's career, for he commenced to specialise in sewerage and sewage purification works, and eventually became one of the leading authorities—if, indeed, he was not the foremost—on those important questions. He very quickly attained prominence in this direction; indeed, soon after Mr. Santo Crimp's death, which took place in 1901, his ability as a sanitary engineer had begun to be widely recognised. Since that time there have been very few of the larger sewage disposal undertakings with which he was not directly or indirectly associated. Lack of space makes it impossible to refer to each and every one of them, and we must content ourselves by mentioning one or two. In doing so we shall not attempt to deal with them chronologically. One of the most important works with which he was connected was the main drainage of Glasgow, for which he was consulting engineer, in succession to Mr. Santo Crimp. An account of the undertaking, which cost over £2,000,000, was given in a paper presented by Mr. Alexander Beith McDonald, the then City Engineer of Glasgow, and himself to the Institution of Civil Engineers and read on March 19th, 1912. The paper contained descriptions of the drainage areas and of the purification works at Dalmarnock, Dalmuir and Shieldhall. In it the following passage occurs:—"The result of the construction and working of the whole scheme has been entirely satisfactory. Solids are completely eliminated from the sewage at the several purification works and the tidal waters of the river have proved to be sufficient to effect the final purification of the effluent. The percentages of purification of the liquid part of the sewage . . . . compare favourably with those produced at any works in the United Kingdom." Those whose memories take them back to the time before the works were in operation can bear full testimony to the extent of the improvement. The design of the works as a whole was got out by Mr. McDonald, the City Engineer, in association with Mr. Santo Crimp and Sir W. R. Copland, M. Inst. C.E., and Mr. Midgley Taylor's part was ably to carry on the work begun by his former partner.

Coming down to a much later date, there was the important sewage disposal scheme designed and carried out by him for the Thurrock, Grays and Tilbury Joint Sewerage Board, which was put to work in 1924. In that case difficulties of a peculiar kind were met with and overcome. The ground traversed by the sewers and of the site on which the disposal works were constructed is of a nature resembling soft newly-made cheese. In an excavation for a trench it was no uncommon thing for the floor to be forced up between the boardings, since the whole ground was, as it were, in a state of flux, and the trouble encountered in the construction of the various tanks and in making the foundations for the pumping station was very serious indeed. Yet, as we have said, all obstacles were surmounted and the whole undertaking satisfactorily carried through. The scheme, it may be added, involved the treatment of an average daily flow of 1,650,000 gallons of sewage and the works are capable of dealing with a maximum flow of 10,000,000 gallons. The pumping station is noteworthy, in that all the pumps are driven by electric motors, the current for which is furnished by oil-engine driven electric generators. The sewage is delivered into sedimentation tanks and is then treated in two sets of bacterial filters, the effluent from which passes to a humus tank. The final effluent is considerably clearer and purer than is the water of the river Thames into which it is discharged!

As showing that Mr. Taylor was by no means so wedded to older methods of treatment as to refuse to adopt newer discoveries, we would cite the case of Reading, for which he designed a scheme to operate on the activated sludge system. The works are intended to treat the sewage from a population of some 90,000 persons—a daily dry weather flow of 3,000,000 gallons. An interesting scheme of quite another type was that which he got out for Falmouth and carried through in a remarkably short space of time in 1925. Before it was put to work the sewage from the town had flowed into the harbour at various points in a crude state. The new scheme was designed to intercept all the pre-existing outfalls and to discharge the sewage into the mouth of the harbour at such periods of the tide as would ensure its being swept out to sea, and not thrown back into the foreshore. A curious point brought out by float experiments was that the best period for the discharge of the sewage was from half flood, through high water, to half ebb. It necessitated the whole of the sewage of the town being delivered to the outfall at such a height that it could be discharged at the level of high water on ordinary spring tides, and that, in its turn, involved pumping the sewage from the low-lying parts, and the provision of a tank to hold 400,000 gallons. Considerable difficulty was experienced in finding a suitable route for the main outfall sewer, as the streets are exceedingly narrow and were already full up with pre-existing sewers, water mains, cables, &c. The route finally chosen involved a considerable length of tunnel, mostly in rock.

Another marine sewage disposal scheme was the successful remodelling of the Portsmouth outfalls, which had originally been designed, many years ago, by the late Sir Frederick Bramwell. On this occasion Mr. Taylor decided to use, for the fixing of the outfall pipes, Portland cement which set with unusual rapidity, because of the very short period that the pipes were entirely uncovered by the tide. He was advised not to employ it, but persisted in doing so, with entirely satisfactory results.

Although, as was pointed out earlier, Mr. Midgley Taylor, having at first devoted his attention solely to water supply, afterwards did more in connection with sanitary engineering, there were occasions, especially in his later years, when he was again called upon to advise concerning water supply undertakings and to design waterworks. It was he who, in conjunction with his brother, successfully added to the potential water supply of Bristol by tapping the Cheddar springs.

We might go on adding to the foregoing list indefinitely; indeed, the examples we have chosen have simply been taken haphazard from hundreds of other examples. Enough has been said, however, to indicate the nature of Mr. Taylor's life's work, and the important part which he played in the progress of sanitary engineering during the major portion of the past half-century.

As might have been expected, having regard to the high reputation which his work had won in this country, Mr. Taylor's advice was several times sought from places abroad. In the year 1908 he visited New Zealand, at the instance of the City of Auckland, in order to make a report upon its drainage. The scheme which he recommended was adopted in its entirety, and was successfully carried out by the City Engineer. Then, too, he went to Singapore and Port Elizabeth, in South Africa, to advise on drainage matters, and he twice went to India to report to the Municipality of Bombay on the drainage of that city, a matter which presented a number of problems that were exceedingly difficult of solution. Finally, just before the war, he spent several months in what was then called St. Petersburg and, as a result, formulated a complete scheme for the water supply and drainage of the city and its suburbs. A full report and estimates were prepared, but the outbreak of hostilities prevented effect being given to them.

During the past twenty years or so there has been an increasing tendency among boroughs throughout the country to extend their boundaries; the majority of our great boroughs have put forward extension schemes, and, as regards the engineering problems which are involved in such expansions, Mr. Midgley Taylor became an acknowledged expert. For by far the greater number of Bills for borough extensions which have been before Parliament during recent years his services were retained, and it is probably not too much to say that, since the war at any rate, the bulk of his time was devoted to that branch of his professional activities. Indeed, he was wont to say that it occupied so much time that he had little left to devote to other subjects. His success in this direction was quite as much due to his excellence as an expert witness as to his engineering skill. Committees in the Houses of Parliament and judges of

GODFRED MIDGLEY TAYLOR

the High Courts alike found in him an expert witness of the first order. He had the ability of conveying to the lay mind, in a few words, exactly the information he desired to impart, and he had, moreover, a masterful personality which always gained for him an attentive hearing. Incidentally, it may be remarked, though it has nothing to do with engineering—saving that he exercised his talent with great effect at the annual dinners of the Association of Consulting Engineers, of the Committee of which he was the first Chairman—that he was an admirable after-dinner speaker.

During the war Mr. Taylor, when so many consulting engineers in Westminster found their work either entirely stopped or very greatly lessened, was continuously busy, partly on that part of his own work the carrying out of which not even the war could entirely arrest, and partly on the planning of water supplies and sewage disposal works for camps, and the construction and equipment of villages for munition works. It is probable that no single consulting engineer was more fully engaged during the whole of the war period than he was.

There is another point of which mention must be made, and that is that Mr. Taylor was one of those who held the view that, in order to provide trained engineers for the future, the engineers of the present must personally attend to their training. While other engineers refused to take them, pupils were always welcomed by him, and he took a very great deal of pains in training and instructing them, and, not only that, but in finding them work when their training was complete. There are large numbers of engineers, many of them holding high positions, who have reason to be thankful that their experience was gained under the watchful eye of Midgley Taylor.

Amongst his many gifts the art of making friends must be given a high place. It is shown by the surprising number of people all over the country who spoke of him just as "Midgley," or preceded it by one of those slang adjectives with which it is common for us to show our affection. Even those to whom he was opposed succumbed to his personality, and after their defeat were only too glad to welcome him as their friend. His transparent honesty of purpose and his clean dealing—he was quite incapable of a mean action—contributed no doubt much to that result, but not a little of it must be set down to the fact that he was an extraordinarily human person, and was ready even in the most technical affairs to see the humorous side. It was high scientific ability combined with a persuading personality and absolute professional rectitude which secured for him the great position which he enjoyed.

JOHN PLATT.

BY the death of Mr. John Platt, on the 10th inst., in a nursing home in London, at the age of seventy-eight, the last survivor of the original firm of Mather and Platt has disappeared.

John Platt was the son of William Platt, one of the founders of this old-established Manchester firm. He served his apprenticeship with Hulses, machine tool makers in Salford, and in the year 1869 joined the firm with which he had ever since been associated, until the time of his death. Within a few years of his joining the firm, Mr. William Platt and Mr. Colin Mather, two of the directors, retired from the board, and Mr. William Mather—later Sir William Mather—took sole control, and Mr. John Platt joined him as a partner. On the technical side Mr. Platt was overshadowed by his partner, and he confined his abilities to the commercial side of the business, in connection with which he travelled abroad for a large portion of his time, visiting Italy, Austria, Germany, and Russia frequently. He was a man who made friends readily, and the trade of his firm benefited greatly by his travels.

Mr. Platt never took any active part in public affairs, but was very thorough and sincere in everything to which he placed his hand. A loyal colleague, with wonderful self-control, it was almost impossible to ruffle him. Some idea of the growth of the firm since his first connection with it in the seventies, can be gauged from the fact that the number of persons employed at the old works in Salford was less than 200, whereas, at the present time, the names on the pay roll are approaching 3000. Up to the time of the great railway fusion Mr. Platt was a director of the Lancashire and Yorkshire Railway Company. He was a justice of the peace for the county of Chester.

Institution of Civil Engineers' Conversazione.

THE conversazione of the Institution of Civil Engineers was held at the house of the Institution, Great George-street, on the evening of Wednesday last, June 15th. A large number of members and guests attended and were received in the Great Hall by the President, Mr. Frederick Palmer, who was assisted by Mrs. Palmer and members of the Council. As befitted the occasion, the various rooms were artistically decorated with flowers. A very enjoyable evening was spent, during which there was an excellent programme of music. Three lectures, which were illustrated by lantern slides, were also given. Sir William H. Ellis presented "Some Notes and Illustrations on Alpine Climbing," while Mr. H. J. Deane gave a short lecture on "The Port of London," and the Astronomer Royal, Sir Frank W. Dyson, discussed "Solar Eclipses." As in previous years, the museum of the Institution was open for inspection and engineering models and examples of scientific apparatus were exhibited in the library and the upper committee room.

Among the exhibits, one of the most interesting, certainly one of the most human, was the Yarrow-Hyde bed for promoting sleep. In recent years Sir Alfred Yarrow has suffered from insomnia. Last autumn during a journey from Vancouver to Montreal he found that he slept far better when the train was moving than when it was still. Recalling the experiments on the vibration of ships which led to the Yarrow, Schlick and Tweedy system of balancing marine engines, he suspended a weight from the roof of the carriage by means of rubber bands and found that there was a vertical movement of from $\frac{3}{4}$in. to $\frac{3}{8}$in., repeated at an average rate of eighty movements a minute. Returning home, Sir Alfred asked the National Physical Laboratory to study the subject. Mr. J. H. Hyde, a member of the Engineering Department staff—and in that capacity more accustomed perhaps to causing fatigue in metals than to relieving fatigue in human beings—was set the problem of devising mechanism which would communicate to an ordinary bed a motion similar in amplitude and frequency to that found in a Canadian-Pacific train. The equipment exhibited consisted of a bed resting on a wooden framework, to which a motor of $\frac{3}{4}$ horse-power could communicate a vertical rise or fall at the head end of anything from zero to $\frac{3}{4}$in., the foot of the bed being stationary. The driving mechanism involved two simple harmonic motions of slightly different amplitudes, which at regular intervals of approximately half a minute came into phase and then passed into opposition. The result was that the bed, instead of constantly vibrating through a set amplitude forty to eighty times a minute, reached that amplitude once every half minute, and then decreased its motion to zero. This varying motion was introduced because of the likelihood that a constant motion would cause nausea. In a new design, the driving mechanism will be placed at the centre, so as to vibrate the whole of the bed, and not only the head. The invention, we learn, is not patented. The provision for adjusting the amplitude and the frequency is necessary, because experience shows that each sleeper has to adjust these factors to harmonise with himself before the best results are secured. From what we have heard, we gather that as a sleep promoter the invention is very effective, at least in Sir Alfred's own case.

Several of the exhibits were identical with those shown at the recent Royal Society Conversazione. Thus, Sir Robert Hadfield exhibited a large number of samples of manganese and other steels and of iron-manganese alloys low in carbon. Professor B. P. Haigh and Mr. F. W. Thorne showed their model for demonstrating the flow of a lubricant in a bearing. The Wembley Research Laboratories, of the General Electric Company, exhibited Selényi's method of observing the "clean-up" in a vacuum lamp. The National Physical Laboratory showed specimens of beryllium, chromium, manganese, silicon and iron of a high degree of purity, prepared in the Metallurgy Department. Another exhibit which, because of its recent description in these columns, need not be described was a 3 horse-power example of the P.I.V. continuously variable mechanical change-speed gear, which was shown by Mr. A. B. Steele.

Mr. H. D. Rice showed samples of "Rubberphalte" road blocks, made of a composition of which we could not learn the particulars. These blocks, of a standard size, 9in. by 4$\frac{1}{2}$in. by 1$\frac{1}{2}$in., are claimed to be cheaper than wood blocks for paving purposes, and to compete with ordinary asphalt. They are laid over a concrete surface by means of a grout consisting of a hot bituminous substance. For the past eighteen months or so they have been in use, in addition to other places, at Acton High-street, with a daily traffic of some 25,000 tons over them. They are claimed to eliminate skidding, to be resilient and silent, and to counteract the transmission of vibration.

Mr. J. Hamilton Gibson showed a model illustrating a method of testing static ventilators placed in the roof of a shed or other building. The apparatus consisted of a model shed, the pitch of the roof of which could be varied and to which natural draught ventilators of various designs could be attached. Against one side of the roof and the ventilator a uniform blast of air was directed, and the effectiveness of the ventilator was determined by the reading of an anemometer placed beneath the roof.

Professor E. G. Coker and Mr. C. J. Dadswell demonstrated apparatus for determining and mapping the elastic and plastic stress areas in twisted shafts according to the Prandtl-Nadai hypotheses. The equipment shown represented the latest developments in the inflated elastic membrane method of determining the extent to which the strain is plastic in a shaft of any section subjected to torsion. Those who heard Professor Coker's recent Thomas Hawksley Lecture will remember the experiments performed on that occasion with plaster of paris, to demonstrate the form of the "roof" corresponding to a given section of shaft under torsion. On Wednesday evening Professor Coker showed several of these roofs reproduced in celluloid and applied over elastic membranes of corresponding outline. On the inflation of the membranes their lines of contact with the roofs indicated the boundary between the areas of plastic and elastic strain in shafts of the appropriate sections when subjected to torsional stress proportional to the inflation pressure. One development consisted of applying a suction instead of a pressure to the membrane, with the object of permitting the form assumed by the membrane to be contoured by means of a pantograph.

Mr. Leonard Andrews exhibited a model of a laboratory elutriator for use in workshops. The ordinary forms of elutriator may take anything from twenty-four hours to several days to separate out a powdered material into several fractions of varying degrees of fineness. Mr. Andrews claims that his form permits the material to be separated into four fractions and the relative amounts of each to be determined in an hour or so. The system employed is the usual one of hydraulic classification, the coarser particles being retained at the points of highest velocity. The equipment is, however, designed to obviate the necessity for the manipulation of the velocities and to overcome various other defects inherent in the ordinary form of elutriator. Its chief feature consists of the provision made for taking off the finest fraction at the earliest stage in the separation instead of allowing that fraction to flow through the whole apparatus before being removed.

The International Standard Electric Corporation had an exhibit comprising, principally, apparatus for the precision measurement of circuit efficiencies as used on the Anglo-American Transatlantic telephone service, and apparatus for comparing the qualities of two loud speakers. The transmission measuring set consists of an assembly of apparatus designed to measure transmission levels on cable circuits, transmission equivalents of circuits or apparatus, and gains of telephone repeaters at any frequency between 50 and 5000 periods per second. The set is composed essentially of two parts. The first part is a "sending" circuit, designed to send out a standard testing power, either directly into the "receiving" circuit for the calibration of the set, or into the apparatus or line under test for the actual measurement. The second part consists of a "receiving" circuit equipped with a device for the measurement of the circuit efficiency required and an amplifier detector, consisting of two stages of vacuum tube amplification, one stage of rectification and a direct-current microammeter. The oscillator used in conjunction with the transmission measuring set is designed to generate alternating current over a frequency range of from 35 to 50,000 cycles per second. The apparatus for comparing the qualities of two loud speakers consists of means whereby either loud speaker may be connected through a resistance pad to the oscillator of the transmission measuring set. The Corporation also exhibited some photographs of the radio telephone equipment at the Rugby radio station, and also photographs illustrating the progress of telephony in Spain.

NEW METHODS OF PRODUCING IRON AND STEEL IN SWEDEN.

AT a recent meeting held at the Jaernkontoret's headquarters, the discussions chiefly turned on methods of reducing the production costs of iron and steel and improving the quality of the products. Accounts were given of the stages reached in experiments with two well-known Swedish inventions—the Flodin-Gustafsson method of direct steel production and the Viberg method of producing a substitute for pig iron as raw material for the Martin process. Professor Arvid Johansson, of the Royal Technical High School, in a paper on the Viberg method, emphasised the lack of first-class scrap iron for the production of iron in Sweden. The Martin Works in Sweden, he said, were using as raw material about 60 to 70 per cent. of pig iron and only 40 to 30 per cent. of scrap iron, which rendered the products dear. In these circumstances iron producers had begun to use iron sponge, but the sponge hitherto produced in Sweden was rather expensive and often contained too much sulphur. The Viberg method of producing iron sponge by an electric process had, Professor Johansson explained, been the subject of numerous experiments at the Sandviken and Domnarfvet Ironworks, which were not yet terminated but which raised hopes of a considerable reduction in price of the manufactured products; it was asserted that iron sponge could be produced by this method at a price of 65 kr. per ton. Speaking on the Flodin method, Count Kalling, the representative of the Uddeholm Company, which is conducting experiments, said that, of the products hitherto obtained, the greatest success had been in cold-rolled pipes. Calculations had indicated a net cost of 91·10 kr. per ton of metal, but that cost was based on exceptionally cheap power and production on a large scale.

THE promotion is announced of Mr. A. C. Cookson from the position of assistant stores superintendent to stores superintendent, Great Western Railway. The change is the result of the retirement of Mr. K. Deans. Engineers will be interested in the fact that Mr. Deans is one of themselves. He is a member of the Institution of Civil Engineers, and before going to the Stores Department at Swindon was an assistant to Sir James Inglis, who was the chief engineer before he became general manager.

STOURPORT ELECTRIC POWER STATION

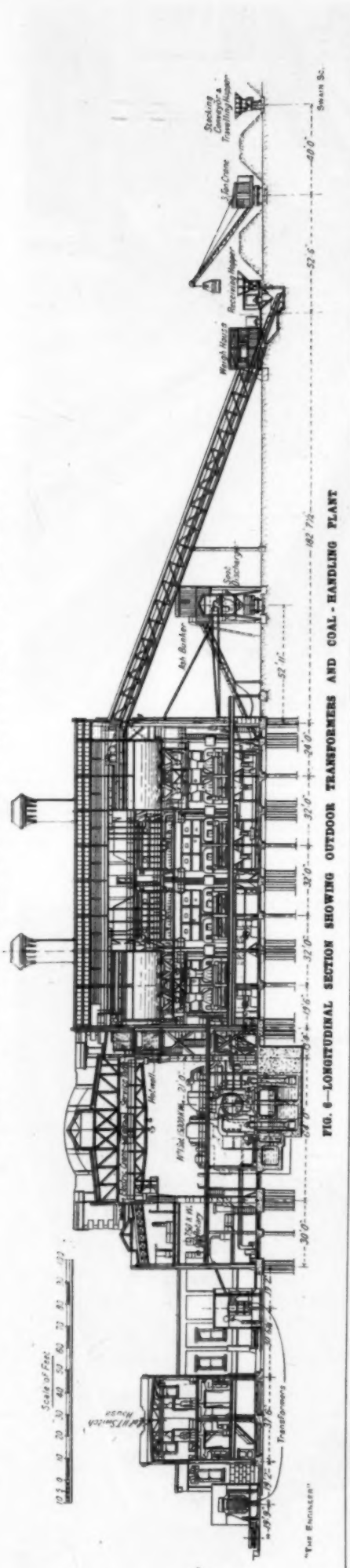

FIG. 6—LONGITUDINAL SECTION SHOWING OUTDOOR TRANSFORMERS AND COAL-HANDLING PLANT

The Stourport Power Station.

No. II.*

THE transformers, which are all of the outdoor type, are situated, as shown in the drawing Fig. 6, between the main control room and the 33,000-volt switch-house, and between the latter and the boundary of the site, where there is a 2500 kVA, 25-cycle, three-phase transformer and six single-phase, 25-cycle transformers forming two 4500 kVA, three-phase banks having a ratio of 33,000/11,000 volts. These transformers, which were supplied by the Brush Electrical Engineering Co., Ltd., and are shown in Fig. 7, serve for the local 11,000-volt supply and for station supply, which is passed through two 500 kVA Brush transformers for the purpose of reducing the pressure to 400 volts. These and sundry other transformers supplied by the Brush Electrical Engineering Company, Ltd., are oil-immersed self-cooled core-type transformers, and the boiler-plate tanks are provided with domed lids, expansion chambers and calcium chloride breathers. For the high and low-tension cables, cable boxes are provided, and on the 33,000-volt boxes an expansion chamber is fitted to permit of the free expansion and contraction of the oil within the cable box, and to this expansion chamber the calcium chloride breather is attached.

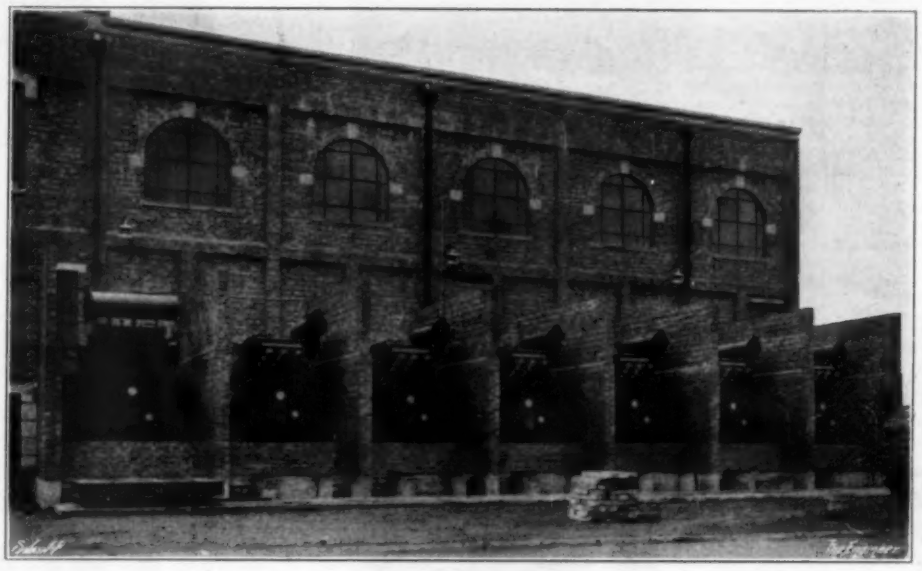

FIG. 7—OUTDOOR TRANSFORMERS

The transformers have local and distance thermometers, which are mounted in the control room. For the sub-stations at Halesowen and Oldbury, which are connected to Stourport by means of underground cables, the Brush Company also supplied two other banks of single-phase transformers, each having a capacity of 7500 kVA and a ratio of 33,000/5500 volts, these transformers being similar to those installed at the Stourport generating station.

The main generator transformers, which were supplied by the Metropolitan-Vickers Electrical Company, are "shell" transformers, cooled on the forced oil system, and each transformer has a capacity of 7500 kVA, a bank composed of three of these transformers being capable of dealing with 22,500 kVA at 0·66 power factor. The ratio is 5500 to 33,000 volts. On account of the weight of these transformers—approximately 30 tons—special arrangements have been made for handling them when repairs or overhauls are necessary. They stand on rails laid over a concrete foundation designed so that, in the event of a tank bursting, the oil would be trapped in a pit immediately below, thus localising the trouble. Moreover, alongside this foundation a truck runs on a 4ft. 8½in. gauge track so as to enable the transformers to be transported to the repair depôt. In order to avoid the oil being thrown on to adjacent transformers or on to any section of the main building in the event of a tank bursting, each transformer is surrounded by brickwork on three of its sides.

In due course the coal will be delivered to the station *viâ* the Staffordshire and Worcestershire Canal, the Great Western Railway and the river Severn, but the section of the station that is now in operation derives its coal solely from the canal. The coal handling plant is designed for unloading coal from barges in the canal basin and for transporting it to the store in front of the boiler-house, or to the bunkers over the boilers, and it is also used for reclaiming stored coal and transferring it to the bunkers. At present each unit of the plant is capable of handling 50 tons per hour, but with slight modifications the capacity can be increased to 100 tons per hour. From the barges in the canal basin—see Fig. 9 on page 664—the coal is unloaded by means of automatic grabs operated from two travelling jib cranes, each having a capacity of 50 tons per hour, and the grabs discharge through travelling receiving hoppers and automatic weighers on to belt conveyors which transport the coal to a ferro-concrete bunker having a capacity of 250 tons. This bunker, which is shown in Fig. 11 on page 664, is divided longitudinally to enable it to hold two classes of coal, which are fed through chutes to specially designed wagons running on

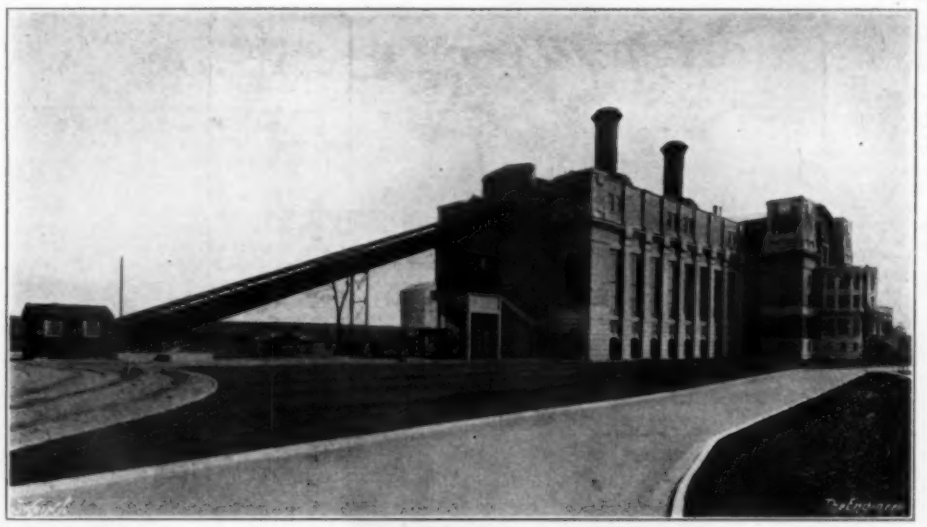

FIG. 8—COAL CONVEYOR LEADING TO BOILER-HOUSE

* No. I. appeared June 10th.

THE STOURPORT ELECTRIC POWER STATION

MR. J. T. H. LEGGE, SMETHWICK, ENGINEER

FIG. 9—COAL BARGES IN THE CANAL BASIN

FIG. 10—COAL CONVEYOR AND STACKER

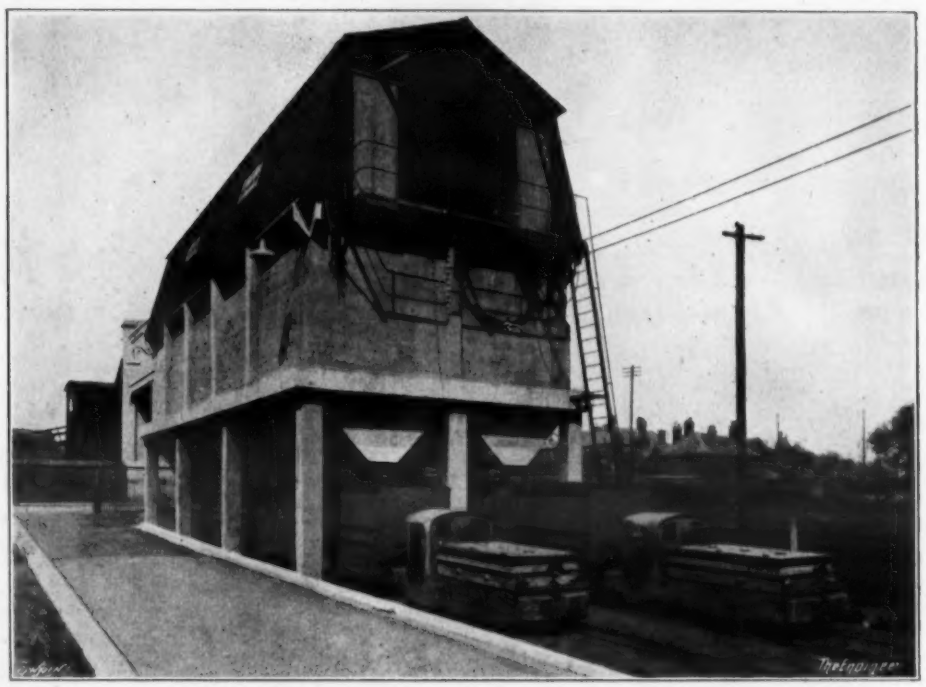

FIG. 11—COAL BUNKER, WAGONS AND ELECTRIC LOCOMOTIVES

FIG. 12—COAL CONVEYOR AND BUNKERS OVER THE BOILER-HOUSE

narrow-gauge tracks laid in duplicate under the bunkers so as to enable either class of coal to be drawn from the bunker.

The wagons, which have a capacity of 100 cubic feet, are hauled by storage battery locomotives running at a speed of over 6 miles per hour and are capable of hauling a loaded train weighing 18 tons to the storage ground adjoining the boiler-house. At this point the wagons discharge into hoppers at ground level on to the storage conveyor, which places the coal in store by means of the butterfly stacker—see Fig. 10 on page 664—which is fed from the main conveyor in such a way that the coal can be divided on each side of the conveyor or distributed on either side. The head of this conveyor feeds the raised bunker, to be seen in Fig. 11, and by means of which the reclaimed coal is returned to wagons for delivery to the boiler-house conveyors. The reclaiming crane is a travelling jib crane with an automatic grab, and it runs parallel to the stacking conveyors and is used for trimming the coal into stock and also for picking from stock and re-discharging either to wagons or direct to the boiler-house conveyors.

The illustration Fig. 8 shows the end of the boiler-house which abuts on the storage ground, and the covered inclined conveyors used for elevating the coal to the conveyors over the boiler-house bunker shown in Fig. 12 on page 664. For the purpose of handling different classes of coal these bunkers are in duplicate, and they also serve as a standby for each other. By means of the tippers in the foreground of the picture the coal is discharged at any desired point in the 1000-ton bunker. At each point in the coal handling system, where it is required to know the amount of coal passing, such as into stock, from stock, into the bunkers, or from the barges, automatic weighers are provided so that it is possible to keep a record of the weight of the coal as it travels. The ash-handling plant, which is placed immediately below the boilers, is of the well-known water-sealed type, in which the ashes after leaving the dumping bars falls through a hopper into a water trough, from which they are carried by a drag link conveyor to a special hopper from which, in turn, they are transferred to the ash wagons.

The contractor for the building work was the Mitchell Conveyor and Transporter Company, of London, which also supplied coal and ash-handling plant, whilst Babcock and Wilcox supplied the steam-raising units and mechanical stokers. The forced and induced draught fans, dust catchers and stacks were supplied by Davidson and Co., Ltd.; the steam, feed and turbine-room pipes and valves by Stewarts and Lloyds, Ltd.; the flue dust extraction plant by Smith and Yates; the revolving circulating water screens by George Waller and Son, Ltd.; and the turbine-room crane by Stothert and Pitt, Ltd. Most of the other contractors have been mentioned, but among the sub-contractors that have not been given are Industrial Combustion Engineers, Ltd., which supplied the steam and air flow meters; Mather and Platt, who supplied the circulating pumps; and G. and J. Weir, who manufactured the extraction pumps, evaporators and automatic valves for the closed feed system. The interconnecting cables were made by British Insulated Cables, Ltd.

Diesel Engine Users Association.

AT the monthly meeting of the Diesel Engine Users Association, which was held on Friday of last week, June 10th, a paper by Mr. Arthur F. Evans, entitled "Consumers' Oil Tests," was read and discussed.

The author said that such tests as did exist and were generally recognised by oil suppliers, fell short of the actual requirements of oil users for the following reasons:—

(*a*) They were not universally adopted by oil suppliers.
(*b*) They did not go far enough to give all the required particulars.
(*c*) They were too complex and difficult for the ordinary engineering firm to carry out with its own staff.

He recognised that it was almost impossible even in a laboratory to test all the properties of a lubricating oil. For instance, there did not yet exist an apparatus for accurately determining the actual lubricating values of oil under the varied circumstances and conditions under which an engine was run. Neither was there a means of ascertaining with accuracy the comparative amount of carbon which an oil would deposit in the combustion chamber of an engine, the closest approach to such a test being the "bomb test," which at its best was but an approximation.

A greater part of the lubricating oil purchased to-day was bought by name and reputation. When the purchaser departed from some known brand, the selection was generally made, apart from commercial considerations, by the colour and the comparative viscosity of the oil at room temperature.

The author said that after many years' experience in the purchasing of oils and in the endeavour to ascertain which particular brand of lubricant was the most suitable for a given purpose, he commenced testing samples of oil which had been submitted to him. Those tests were, however, at first, limited in value as they furnished information which in the main was only of utility to himself, and the realisation of that fact had induced him to place the tests on record in such a form that they could serve as a basis for a series of tests that might readily be carried out by any engineering firm.

Mr. Evans then dealt in detail with the various tests which he suggested should be carried out, and went on to give some interesting information with regard to the apparatus which was necessary in order to make the test. The method of using the apparatus was also described.

DESCRIPTION OF OIL TESTS.

Test (1): *Fire Test.*—The sample is gradually heated in an iron pot till sufficient vapour is produced to just sustain a blue flicker of flame across the surface. The temperature at that moment is the "Fire Test."

Test (2): *Freezing.*—The temperature of a sample contained in a standard test tube (¾in. by 7in.) is gradually lowered from 40 deg. Fah., and at every degree the sample is observed by turning the tube to a horizontal position and counting three seconds. If no appreciable movement is noticed by that time the sample is considered to have "Frozen."

Test (3): *Water Content.*—The sample is placed in a small beaker and a clean ¼in. steel rod is heated to about 1000 deg. Fah. and dipped in the sample. If there is a trace of water present a slight frying noise will be noticed.

Test (4): *Redwood Viscosity.*—This is the usual Redwood test at the temperatures specified, viz., 70 deg., 140 deg., and 200 deg. Fah.

Test (5): *Low Temperature Viscosity.*—A given quantity of oil is placed in a standard tube which is then immersed in a bath and brought to the temperature required. The tube is then placed in a horizontal position on a gauge and the time noted for the oil to flow to a definite mark. The time in seconds lapsed is the tube flow viscosity. A test is taken at 70 deg. Fah. for reference to the Redwood figure. It is not practical to carry the test below 32 deg. Fah.

Test (6): *Emulsification.*—Five parts of the sample of oil and five parts of distilled water are placed in a standard test tube and are thoroughly mixed for a given time at a temperature of 100 deg. Fah. The amount of water that separates out, the amount of definite emulsion, and the clear oil separation are measured in percentages of the whole at intervals of one hour, twenty-four hours and fourteen days.

Test (7): *Decomposition or Heat Test.*—The sample, contained in a standard tube, is placed in an oven and subjected to a temperature of 500 deg. Fah. for 200 hours, the temperature being regulated by a thermostat. The evaporation is then read off. The tube flow viscosity is obtained as per Test No. (5), but at a temperature of 60 deg. Fah. The characteristics of the residue are also noted.

In conclusion, the author said that it was to be regretted that there did not exist an apparatus for directly determining the amount of resistance to extension, as, if such was available, then the fundamental value of an oil would be the figure supplied by such a machine and the other properties of an oil would be complimentary or conditional.

Samuel Crompton Centenary.

THE centenary of the death of Samuel Crompton (1753–1827), inventor of the spinning machine that came to be known as the "mule," was commemorated at Bolton on June 5th to 9th.

Among the outstanding inventions that revolutionised the textile industry during the eighteenth and early nineteenth centuries—Kay's fly shuttle, Arkwright's cotton preparing and spinning machinery, Hargreaves's spinning jenny, Crompton's mule, Cartwright's power loom, Jacquard's cards for intricate weaving and Heilmann's wool comber—none takes a higher place than Crompton's mule. It made possible the large-scale production, not only of the coarser counts of yarn, but also of the very finest counts for warp and weft alike, and helped largely to create the modern cotton industry which is rooted in Lancashire and has ramifications throughout the world among the producers of raw cotton and the buyers of cotton goods. Not only so, but the textile machinery industry, so important to engineers, has grown up concurrently to meet the requirements of the trade so created.

Samuel Crompton spent his whole life in Bolton and its immediate neighbourhood, and it was therefore appropriate that the commemoration should be held there; it must be recorded that the town rose splendidly to the occasion. The local proceedings comprised a visit by the Mayor on Sunday, June 5th, to the Swedenborgian church with which Crompton was actively associated; a historical and symbolical pageant introducing scenes from the life of Crompton; visits to Firwood Fold, Crompton's birthplace, to Hall i' th' Wood, his home when he invented the mule, and to King-street mill, where he worked his early machines; processions to his burial place in Bolton parish churchyard, where a service was held, and to his statue in Nelson-square, where wreaths were deposited. In addition, a special exhibition of old textile machinery had been got together at the Chadwick Museum, among the exhibits being one of Crompton's mules actually working. At the Technical College an exhibition of selected textile machinery, much of it in operation, was open to the public.

The Textile Institute had decided to hold its Conference this year at Bolton, and marked the occasion by taking a prominent part in the commemoration proceedings, as well as by devoting the morning sessions to papers for the most part of an historical character. These papers were as follows:—"Samuel Crompton," by H. W. Dickinson, of the Newcomen Society for the Study of Engineering and Technology; "The Early Machinery of the Cotton Industry," by Frank Nasmith, F.T.I.; "Crompton's Invention and the Subsequent Development of the Mule," by W. Scott Taggart; "Mill Construction," by Harold Hill, F.T.I.; the Mather Lecture, "Industrial Lancashire Prior and Subsequent to the Invention of the Mule," by Professor G. W. Daniels, M.A.; "Steam Power in Evolution," by David Brownlie, B.Sc.; "Loom Developments," by W. Wilkinson.

The International Federation of Cotton Spinners and Manufacturers also took part in the commemoration by sending delegates.

As one would expect, there was much entertainment, which took the form of a civic reception and a banquet, a luncheon given by the Bolton Cotton Trades' Employers' Associations, and another by the Bolton and District Engineering Employers' Association.

A considerable number of textile and general engineering works, spinning and weaving mills, bleach works, &c., were open to inspection during the time.

THE MINERAL WEALTH OF CORNWALL.

AT the summer meeting of the Royal Cornwall Polytechnic Society, which was held at Truro on Friday, June 3rd, Mr. F. J. Stephens read a paper on "The Ancient Mining Districts of Cornwall." Mr. Stephens said that an extraordinary fact revealed in a study of the past history of Cornish mining was the frequency with which the Cornish miners overlooked, and even threw away at times, ores that afterwards were found to be valuable. There were no geological reasons why gold ores should not exist in payable quantities in veins in Cornwall, but the fact remained that, beyond occasional sporadic appearances, payable gold ores had not yet been discovered in West Cornwall. Silver had been recognised in the county for ages past, and the mines worked for silver ores had been quite numerous, yet there were cases of thousands of pounds of silver ores having been thrown away as valueless. Quite a quantity of silver might reasonably be expected to be met with in western mines. In all probability many thousands of pounds' worth of silver ores had been thrown away in the workings of long-abandoned mines. He was not aware of any localities, outside New Terras and Trenwith Mines, that had ever been searched systematically for uranium ores. Years ago many tin miners were troubled with the presence of wolfram, but wolfram ores were now a very valuable asset owing to the application of tungsten to the manufacture of hard steel.

Much hidden wealth was still to be found in many ancient mine waste heaps or burrows which dotted the abandoned mining districts of West Cornwall. It was obvious that modern research had brought to light much that was unknown at the times when those mines were being actively worked, and that would do much to help to turn that hidden wealth to account. With tin at £300 a ton—more than three times the value of the metal when the great majority of those mines were finally abandoned—it seemed somewhat extraordinary that such districts as Wendron, St. Hilary, Perranuthnoe, and Germoe, St. Agnes and Perranporth, in which there were many mines that had produced much tin and were quite shallow, should not by this time be full of prospecting adventurers. There was more mineral wealth in Cornwall, and especially West Cornwall, awaiting to be turned to account than had ever yet been taken out.

THE BRITISH ENGINEERS' ASSOCIATION.

AT a luncheon given by the British Engineers' Association at the Hotel Cecil on Thursday, June 16th, with the President, Mr. H. J. Ward, in the chair, the principal speakers were the Right Hon. Reginald McKenna, P.C., and Sir Arthur Balfour. In a short speech Mr. McKenna pressed for an inquiry into the British banking system. Although the Chancellor of the Exchequer had said that such an inquiry could not be made without causing unsettlement in many directions, many other nations had made such an inquiry, and he instanced particularly the work that had been done by the United States and the beneficial effects of the Federal Reserve system which had resulted. He still felt that our system of credit lacked flexibility, and was convinced that a full inquiry was desirable.

Sir Arthur Balfour, who has recently returned from the Economic Conference at Geneva, where, we may add, he worked from nine o'clock in the morning till past midnight, gave a brief account of the work of the Conference. He commended particularly the masterly Memorandum contributed by the British Engineers' Association, and complimented Mr. Bremner upon its compilation. It was impressed upon him at the Conference that agriculture was the key industry, and that its full development was essential to progress. Amongst the good work done at Geneva was an attempt to make the statistics of all countries directly comparable, and so to avoid the confusion that now existed. The question of cartels came in for a good deal of discussion, and there were those who arrived at Geneva with the belief that they were the only solution of industrial difficulties. They left with quite other views, and it was shown that cartels had not the effect, as they supposed, of reducing tariffs, but quite the reverse. He felt that the best control of cartels was to be sought in publicity, and the less there was of governmental interference the better. Trade organisations were needed, but they should be, as the British Engineers' Association was, conducted by practical people engaged in the industry, and not by Government officials. The knowledge of international negotiations was essential, and he deemed it desirable that young men should be trained in it. He ended on a note of optimism. After stating that it was time for the country to say, once and for all, that it would not have communism, he added that the best cure for communistic propaganda was the improvement of relations between employers and employed. That being achieved, he expressed his conviction that Great Britain would win triumphantly through her present difficulties and re-establish herself in her old industrial position.

The short toast list concluded with a few remarks from the admirable secretary of the Association, Mr. D. A. Bremner.

ELECTRIFICATION is practically completed on the Lausanne-Berne line of the Swiss Federal Railways, and electrically driven trains are now running on the Lausanne-Romont section.

"Clear Space" Pneumatic Power Hammer.

REALISING that certain classes of work require more space above and around the anvil block than is provided in their pneumatic power hammers of the overhanging form provided with slides, B. and S. Massey, Ltd., of Openshaw, Manchester, are now introducing a range of hammers which provide adequate "clear space" above and around the anvil block for the easy manipulation of bulky tools and jobs. These new machines are specially designed to take the place among pneumatic power hammers of the firm's "Rigby" type steam hammers. In the "Clear Space" hammers—see Fig. 1—as in the steam hammers, slides are dispensed with, the piston, piston-rod and tup being forged in one solid piece with two flat surfaces on the rod to prevent its turning. To compensate for the absence of slides, the rod is of extra

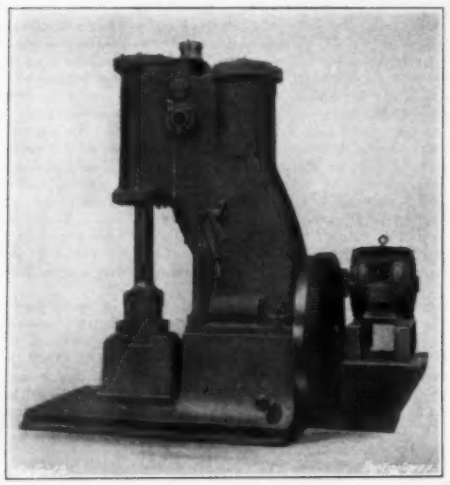

FIG. 1—"CLEAR SPACE" PNEUMATIC POWER HAMMER

large diameter, and a specially deep piston and stuffing-box are provided. As in the case of the overhanging type of pneumatic hammer made by this firm, the hammer cylinder, pump cylinder and valve chest are in one casting, and the valve chest is fitted with a renewable tube or liner, ground to size after insertion. The air valve is of special design to fit the tube.

The hammers are controlled by a hand-lever and the driver has an uninterrupted view of the work. By means of a special valve gear a series of automatic blows or single blows from any point in the stroke can be struck, the blows in either case being light or heavy with long or short strokes as desired. The single blows are obtained without the use of a timing device and without fear of a second blow following unintentionally, since a separate movement of the controlling lever is required for each blow. The tup rises with a smooth continuous movement, will hold up at any point in the stroke, and hold down so as to grip work

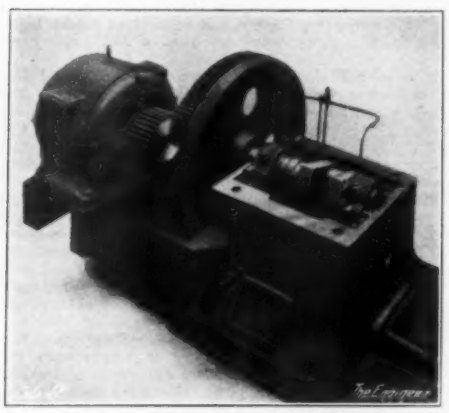

FIG. 2—BASE-PLATE ARRANGEMENT

between the pallets. The smaller hammers can be provided with a foot-lever in addition to the hand-lever, so that for many jobs the smith can operate the hammer himself.

An interesting and important feature of these "clear space" hammers is the automatic lubricating system which is illustrated by Fig. 2. The lower portion of the standard forms an oil sump into which the big end bearing dips at each stroke. A pump, actuated from a cam on the crank shaft, keeps a constant supply of oil running through the crank shaft bearings and back into the sump. This pump also supplies oil by a pipe to the cylinders, valve chest and small end bearing, a test pipe and regulator being provided on this pipe in a convenient position.

As will be seen from the engravings, the standard forms an enclosed space in which all the working parts are well protected from dirt and grit. Such exhaust as occurs from the cylinders is led into this enclosed space, and is therefore well muffled. Inspection holes with covers are provided in order that the working parts may be examined periodically and any necessary small adjustments can be made without dismantling the hammer.

South African Engineering Notes.

Suburban Railway Electrification.

IT is authoritatively stated that the scheme for the electrification of the suburban railways is so far advanced that the first experimental electrically driven train will run from Cape Town on the Sea Point line in July. The length of the line is about 3¼ miles. In August there will be a regular electric train service. The necessary power will be supplied by the Dock-road power station, Cape Town, through a sub-station at Three Anchor Bay, half-way along the line, until the new generating station, which is being erected at Salt River, some 2 miles from Cape Town, is completed, which will be towards the end of the present year. Each train will be composed of three trailer coaches and three motor coaches. Each motor coach has 750 horse-power.

When, in addition, the electrification between Cape Town and Simonstown, about 22 miles, is completed, the whole suburban scheme will involve the use of eighty-three motor coaches, thirty-five driving trailer coaches, and ninety-seven ordinary trailer coaches. All the motor coaches were built in Germany, and most of the parts were already in Cape Town by the middle of April. The "driving trailers" were made in Belgium, and the ordinary trailers in England. All the electric motors and equipment is being supplied by the English Electric Company. It is stated that one of the German motor coaches, under the contract, has been tested for five months in England and found thoroughly satisfactory.

There are six sub-stations. The Dock-road and Salt River power stations will, when the latter is completed, be interconnected. The biggest machine at the Dock-road station is a 7500-kilowatt alternator, and the total capacity at present is 21,000 kilowatts, but another 7500-kilowatt alternator is being installed. At the Salt River station three-phase alternating current will be generated at a pressure of 12,000 volts by three 10,000-kilowatt alternators, driven by turbines of the impulse type, giving in all over 40,000 horse-power. The maximum output of each of the machines at Salt River is 16,500 kilowatts for two minutes; the continuous rating being 10,000. Later on, when required, a fourth machine will be installed.

One of the most interesting features in connection with the Salt River power station is the provision of water for the cooling system. Owing to the necessity for an unfailing supply of electric power throughout day and night, precautions are taken with regard to the three condensers by installing two separate and independent supplies of circulating water. Sea water will be admitted by gravity through two 72in. concrete pipes, which are now being laid out to sea, terminating at a tower which eventually will just rise above the waves nearly a quarter of a mile from the shore. The pipes are laid parallel, and between them over the entire length is constructed a gallery—also under the water—6ft. high by 3ft. wide, from which at intervals of about 200ft., access is gained to either of the pipes through water-tight doors. Over the first section of the work, for a distance of 350ft., till low-water level is reached, a canal will carry the discharge water back from the power station to the sea. That is the only part of the work which will be visible above water when the pipes are finished. The tower at the end will be 70ft. overall, and will house the valves and the machinery. In addition to supplying the power for the electrification of the suburban lines, the Salt River power station will assist the Dock-road station, should that be overtaxed, and also provide a supply of power to other consumers at points as far distant, if need be, as 200 miles. At present, however, the zone on which the Salt River power station is the centre is contemplated as having a radius of somewhat over 50 miles.

Three-cylinder Locomotives.

The two so-called experimental locomotives recently ordered from Germany by the South African Railways are to be three-cylinder simple engines having a 2-10-2 wheel arrangement and designed to exert a maximum tractive effort of 53,200 lb. The most powerful non-articulated steam locomotives so far in service on the South African Railways have a draw bar pull of 40,744 lb., so that the three-cylinder engines mark a considerable advance in effort. These engines will have an inside cylinder driving the second pair of coupled wheels, while the two outside cylinders will drive the third pair. The General Manager's "Bulletin" gives particulars of the design. The frames will be of the bar type, and to ease the negotiation of curves a special articulated arrangement is being provided at the front end of the locomotives. The distinctive features will include self-cleaning smoke-boxes, mechanical stokers, steel fire-boxes, with arch tubes to support the brick arch, "Franklin" automatic fire-hole door, top water feed, and grease lubrication, a form of lubrication which was first introduced on the South African Railways with the advent of the "Karroo" and "Mountain" types of locomotives in 1925. The leading dimensions of the locomotives will be as follows:—

Cylinders, diameter	22in.
Cylinders, stroke	28in.
Wheels—	
Coupled, diameter	4ft. 9in.
Leading truck, diameter	2ft. 6in.
Trailing truck, diameter	2ft. 9in.
Rigid wheel base	15ft. 9in.
Total wheel base	38ft. 2½in.
Boiler—	
Diameter inside at front	6ft. 2½in.
Length between tube plates	21ft.
Height of centre from rail	8ft. 6in.
Pressure	200 lb. per sq. in.
Grate area	56 sq. ft.
Heating surface—	
Fire-box	258 sq. ft.
Tubes	2942 sq. ft.
Superheater	828 sq. ft.

The tenders in appearance are not unlike those introduced with the "Karroo" and "Mountain" types of locomotives. The water capacity will be 6000 Imperial gallons and the fuel capacity 14 tons. In working order the engine and tender together will weigh 206 short tons.

On arrival the new locomotives will be put to work in the first instance on hauling mineral traffic on the Witbank–Germiston line. The single train load they will be called upon to convey will be in the neighbourhood of 1850 tons. The coupled wheels, having a diameter of 4ft. 9in., will enable the locomotives to maintain a fairly high average rate of speed, which should allow of the round trip between Germiston and Witbank being comfortably undertaken in a working day.

Dunswart Works Expanding.

Owing to increased business, the Dunswart Iron and Steel Works Company has found it necessary to enlarge its plant. The 18in. rolling mill has been removed to a more convenient site adjoining the 8in. and 12in. mills, while a new 18in. forge mill has been added, which will materially improve the quality of wrought iron bars manufactured and also reduce costs, thus benefiting the consumer. The steel foundry space has been considerably enlarged, which will enable the company to cope with more than double the amount of steel castings. All alterations are being done with a view to time-saving and speeding up deliveries. At present, no casting in use in South Africa is too large for the company to duplicate.

Sir William Hoy to Leave the S.A.R.

It was recently officially announced that Sir William Hoy, K.C.B., general manager, South African Railways and Harbours, has accepted the chairmanship of the Rhodesian Railway Commission, and will assume the appointment early next year. Sir William Wilson Hoy was born in 1868 in Kinross-shire, Scotland, and was the son of the late Robert Hoy. In 1880 he entered the service of the North British Railway Company, Edinburgh, and joined the Cape Government Railways in 1889. He was Chief Traffic Manager, 1891; appointed C.G.R. representative in Johannesburg, 1896; Assistant Traffic Manager, Bulawayo, 1897–98; Kimberley, 1898; Port Elizabeth, 1899; Traffic Manager, Bloemfontein, with control of I.M. Railways, from June, 1900, till June, 1902, when on transfer of the railways to the Civil Administration, he was appointed Manager of the C.S.A.R. He represented the C.S.A.R. at the International Railway Congress at Washington. Was appointed as Assistant General Manager, January 1st, 1909, and General Manager of the S.A.R. on the union of the Colonies in 1910. He was also a Director of Military Railways, with rank of Colonel in 1914. He was awarded the C.B. for service in the South-West African campaign; appointed Commandeur de l'Ordre de la Couronne (1919); appointed Knight of Grace of the Order of the Hospital of St. John of Jerusalem in England (1919).

Pretoria Steel Foundry.

A recent addition to the Pretoria Railway Workshops is a steel foundry. Up to the time that it was erected and put into operation, all the steel castings required for rolling stock had to be imported. Perhaps the need for the establishment of such an industry was never so evident as during the period of the Great War, for during that time it was often impossible to obtain steel castings, and cast iron or forgings had to be resorted to as a temporary measure. The steel foundry during its brief existence has proved beyond doubt the absolute necessity for such a department in relation to railway workshops. The Pretoria Foundry, being the only one connected with the Railway Administration's activities, is naturally hard pressed to meet the demand for castings required throughout the Union, and, in fact, in the near future the present shop will be enlarged and the plant materially added to.

The foundry is separated from the main workshops as a suitable position for its erection was not available in the workshops proper, and the probability of future extensions had also to be considered. The building, which is entirely of modern design and construction, is situated at the eastern end of the workshops in the vicintiy of the running shed. The shop is well equipped with plant and machinery. Three overhead electric traverser cranes are provided, and run the full length of the shop. There is also the following plant and equipment:—Cupola, converter, air compressors, fans, crucible furnaces, bogie core-drying stoves, and annealing ovens, grinding mill and sifter, coke bins, emery grinders, sand bins and riddles, steel ladles, moulding machines, pig iron breaking machines, &c. In addition, there is a laboratory where the chemical analysis and testing of materials are carried out. The steel foundry's sphere of usefulness is practically unlimited, and the following are among the list of castings made:—Locomotive axle-boxes, bogie centres, horn stays, frame castings, bogie bolsters, crossheads, wheel centres, &c. The converter is of the Tropenas variety of 2-ton capacity. The advantage of the small converter is evident where steel castings are produced on a small scale, for it may be used one, two or more days per week, and shut off with no disadvantages and little cost, beyond the loss of heat at the end of the day in cupola and converter, which is a small matter. Chemical analysis and physical tests are carried out in a laboratory provided for that purpose.

SOME particulars are given in *Power* of the 25,000 horse-power hydro-electric installation which has recently been completed at St. Narcisse on the Batiscan River, Canada, 20 miles from Three Rivers, Quebec, by the Shawinigan Water and Power Company. The site was originally developed in 1890 for a capacity of about 1500 horse-power in three units, operating under a head of 80ft., the power being transmitted to Three Rivers at 15,000 volts by, it is claimed, the first h.p. line in the British Empire. The water is now carried to the new plant, some 4200ft. away, where a head of 160ft. is obtained. The tunnel terminates in a reinforced concrete surge tank from which two penstocks lead down to the 12,500 horse-power turbines. The generators are supported on concrete pedestals, and the operating floor is level with the turbine floor. The station will have an ultimate capacity of 50,000 horse-power.

ELECTRICALLY-DRIVEN DRY-GRINDING MACHINE

B. R. ROWLAND AND CO., LTD., REDDISH, ENGINEERS

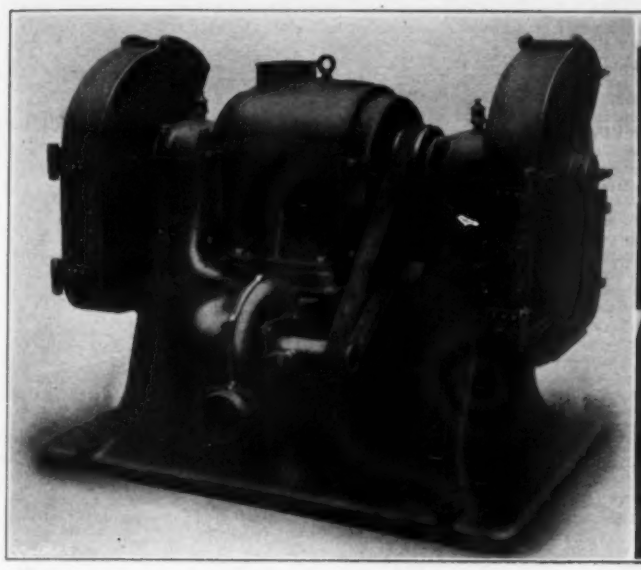

FIG. 1

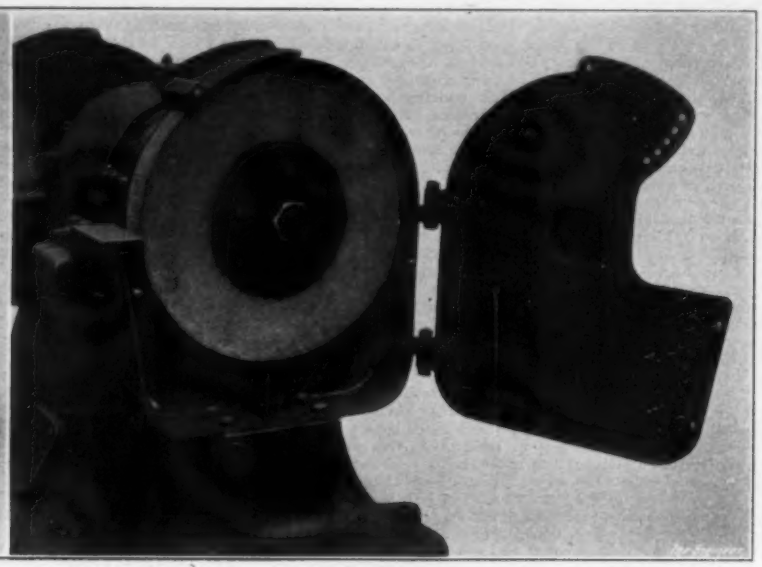

FIG. 2

Electrically Driven Double Dry-Grinding Machines.

THE accompanying illustrations, Figs. 1 and 2, represent the most recent type of electrically driven double dry-grinding machine, made by B. R. Rowland and Co., Ltd., Reddish, near Stockport, who have just built twenty-eight machines of this type for the New Zealand Railways. This machine, which is built in several sizes, carrying wheels from 14in. to 30in. diameter, embraces several important improvements in detail, and is particularly intended for fettling purposes in foundries, steel forgings or for constructional work, such as sections, angles, &c. The machines are of substantial construction in order to give the necessary rigidity. The wheels are mounted on dovetailed safety plates, specially gritted and graded for the work which they are intended to perform.

A special feature which should be mentioned is the dust exhaust apparatus. It comprises a fan furnished with ball bearings and fitted at the rear of the machine, as may be seen in one of the engravings. It is arranged to be driven direct from the main spindle by means of a belt. The dust is drawn through passages in the backs of the guards, below the wheels and into the body of the machine, which forms a reservoir, and the lighter portions of the dust are discharged by the fan.

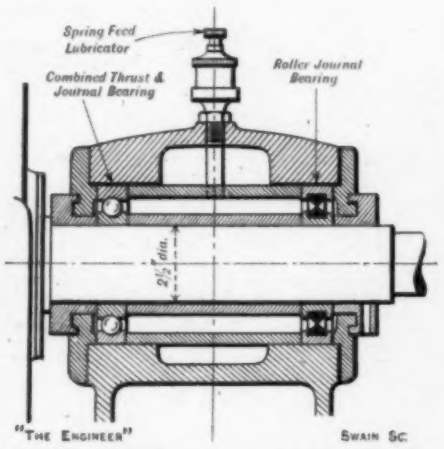

FIG. 3—COMBINED BALL AND ROLLER BEARING

The driving motors can be either of the alternating or direct-current types, and in either case they are completely enclosed. They are specially designed for this class of duty and are without bearings, the shaft, which is extended on either side of the motor, and furnished with dustproof glands, being carried in the grinding machine bearings. The bearings are supplied by the Hoffmann Manufacturing Company, Ltd., and are of the anti-friction type. One bearing has two sets of rollers and the other one set of rollers, and one combined journal and thrust ball bearing to locate the shaft endwise.

Special means have been devised to protect the bearings from undue wear, which might be caused by grit finding its way into the housings. In order to keep the latter dust-proof, intricate grease seals are provided. These seals consist of a series of annular tongues and grooves—as shown in the drawing, Fig. 3—and into these the grease is forced in the usual way. Extreme care is taken in fitting the bearings, and their races are held in position by means of end plates on the housings for the outer races, together with distance pieces, a shoulder on the shaft, a distance piece and circular nut on the end of the spindle for the inner races. The space between these distance pieces is packed with grease supplied by a spring lubricator.

Heavy arms on the body of the machine are planed to receive the adjustable grinding wheel rests, and a cleaning-out door is fitted.

These machines are equipped with a new type of steel safety guard, which has been designed to meet the Home Office requirements. This guard is shown very clearly, closed and open, in Fig. 1 and Figs. 2 and 4. The guard is made of boiler plate steel throughout and welded, the thickness of the periphery and side plates being, if anything, greater than that specified in the Home Office regulations. The guard is of simple construction, the peripheral member at the back being formed into one piece by welding. The hinged side door is provided with a cover for the protection of the spindle nut which can be opened by the removal of four nuts.

The guard has an adjustable nose piece which is, if anything, of greater strength than the main portion of the guard. It is fitted at the back and a substantial piece of steel welded on the top at the front is drilled to receive a bolt which forms the means of adjustment, together with a series of holes in both side cheeks.

FIG. 4—A WHEEL TESTED TO DESTRUCTION

Severe tests of these guards have, we understand, been recently carried out by the makers in the presence of the Chief Factory Inspector, and the result of one of the over-speed tests is shown in the illustration, Fig. 4, which shows a 24in. grinding wheel that burst at a speed of 9400 revolutions per minute. No portion of the wheel escaped from the guard, which withstood the shock satisfactorily. The normal running speed of the wheel, it should be stated, was 5000 revolutions per minute.

In the case of belt-driven machines, the dust extraction fan is connected by steel tubing to snouts fastened behind the wheel, whereas in the case of the motor-driven machines the fan is bolted on to the body and is driven direct. The main body casting forms a reservoir and the dust is drawn through the hole at the back of the guard below the wheel. A baffle is fitted under the guard below the wheel to collect the heavy dust and so protect the fan and piping from unnecessary wear.

A NEW coal pit is to be sunk to the north of Seaham Harbour, at a cost of £1,000,000. The ultimate output will be a million tons of coal a year.

Twenty-five Years in the Dry Cell Industry.*

By C. A. GILLINGHAM.†

THE first practical primary cell constructed along the lines of the "dry cell" of to-day was produced by Gassner in the year 1888. For the first few years the dry cells produced were all of the large size, which we have come to know as the "standard" dry cell, typified by the 2½in. by 6in. (6·4 cm. by 15·2 cm.) size, found on the shelves of every hardware dealer. There soon appeared a miniature type known as the "flashlight" cell. These two types have developed along quite different lines. Between 1899 and 1926 the production of standard dry cells had increased thirty-five fold, and now amounts to many millions annually.

• Dry cells were at first used for little except laboratory work. Their advantages over the then commonly used Leclanché wet cell, however, soon led to their general use for operating door bells, annunciators, &c. Then followed a period beginning about 1904, during which the demand for standard dry cells increased immensely, owing to their use as the source of electrical energy for automobile ignition systems. This gave rise to the so-called "ignition" type. The advent of the magneto reduced this demand, but for many years their use as a reserve source of ignition and when starting the engine, called for considerable quantities. The starting and lighting systems of to-day finally put an end to this demand.

Simultaneously with their use for automobile ignition, they came to be generally employed for operating telephones. This rapidly developed into a large demand, which has continued without decline, in spite of the fact that central energy systems are being installed in most large exchanges. This is attributed to the continuous reaching out of the telephone into rural districts where central energy cannot be employed. For telephone purposes also a special type of cell has been developed. During the last few years an enormous demand for dry cells has resulted from their application to the "A" circuits of radio receiving sets, and this, in turn, has given rise to a special type of cell adapted to the heavy demand imposed upon it in radio service.

The miniature or flashlight type of cell, an offshoot from the standard type, some time about 1900, has grown more rapidly than the latter and attained larger proportion. The flashlight cell was first used in connection with the carbon filament miniature lamp in small pocket flashlights. The popularity of these was increased greatly by the advent of the tungsten filament, with its greatly improved efficiency and candle power, some time about 1910. At an early date ear-phones for the deaf also came into use, and demanded batteries of miniature cells as a source of energy. The advent of radio, in which batteries of miniature cells are used for operating the "B" circuit, caused a tremendous expansion in the industry. Its rapid growth during the past six years is indicated in Table I.

TABLE I.—*Cells for Radio "B" Batteries.*

Year.	Estimated rate of increase in production of batteries
1921	1
1922	17
1923	83
1924	250
1925	380
1926	500

In the early days of the industry the standard dry cell was manufactured in a variety of sizes. In the round types cells 4in. 5in., 5½in., 6in., 7in. and 8in. (10·2 cm., 12·7 cm.,, 14 cm., 15·2 cm., 17·8 cm., and 20·3 cm.) high were marketed. Besides these, there were numerous sizes in rectangular shapes, and several sizes in oval shapes. At the present time, however, the 6in. (15·2 cm.) high, round cell is practically the only one manufactured, all the others

* Paper read at the fifty-first general meeting of the American Electrochemical Society, April, 1927. Abridged.

† Of the National Carbon Company, Cleveland, Ohio.

having been either completely discontinued or reduced to a negligible fraction of the industry's output.

The first dry cells were of what may be called the plaster-lined construction, in which a zinc can was coated on the inside with thick layer of plaster paste containing electrolyte, within which was packed a depolarising mixture with a carbon electrode in the centre. These electrodes were usually flat carbon plates. This construction, however, soon gave way to the paper-lined type, in which the zinc can is lined with a single or double thickness of paper board, within which the depolarising mixture and a round electrode are tamped. This construction has persisted with little change to the present time. It is cheap, safe and efficient. The bag type of construction has been tried in the larger sizes of cell on numerous occasions, but has not proved generally satisfactory for manufacturing and economical reasons.

The sizes in which miniature cells first appeared were the ¾in. by 2¼in. (1·9 cm. by 5·4 cm.) and 1¼in. by 2¼in. (3·2 cm. by 5·7 cm.). Due to the introduction of all sorts of novelties using batteries of miniature cells, a long list of sizes soon developed. Within the last ten years, however, the trend of manufacturers towards standardisation has caused the virtual elimination of all but six sizes of miniature cells. Other sizes are still manufactured, but only in small quantities and for rather special purposes.

The first minature cells were of the paper-lined type, as were the 6in. cells made at that time. It was soon found, however, that a more efficient and reliable article could be produced if the bag type construction were employed, and for many years past miniature cells have been made almost exclusively in this form. Recently, however, one manufacturer has reverted to a method of manufacture involving the paper lining. Just within the last two years an entirely new form of cell has been developed as a substitute for the cylindrical type assembled into "B" batteries. This consists of flat elements laid up together in the proper order to form a group of cells in series. This construction, while admirably adapted to "B" batteries, does not lend itself to independent single cells.

The quality developments in the dry cell industry have been dependent to a large extent on the development of the tests by which the quality is gauged. One of the first tests applied to dry cells was the determination of open circuit voltage or approximate E.M.F. Because it has been found to reflect very accurately the presence of internal defects, it has come to be an important factor in the manufacture of cells. The determination of internal resistance likewise came into early use, in an attempt to measure quality, but because it is a slow, clumsy and unreliable determination, and tells but little with regard to the merit of the cell, it has been almost entirely discarded. Short-circuit ampèrage early came to be considered a valuable indication of perfection and uniformity of manufacture. This test is now of tremendous importance, especially in connection with the marketing of the standard dry cell. It was soon found that the short-circuit ampèrage taken on the same cell at various ages provided valuable information on the rate of its deterioration with time, and thus the so-called "shelf-life" test came into existence.

By none of these means, however, could an indication be obtained as to the electrical performance or output of the cell when in service. The need for such an indication early led to the evolution of a series of "service capacity" tests, which have been of the utmost importance to the dry cell's growth from a quality standpoint.

These service tests have developed along different lines for the different types of cell. In the case of the standard dry cell, the earliest attempts consisted in discharging the cell continuously through various fixed resistances, usually of low values, and determining the rate of exhaustion by observing the decline in the cell's working voltage. It soon came to be recognised, however, that these continuous tests did not involve any measure of the cell's recuperative ability. This proved to be of major importance. Intermittent tests of varied character accordingly came into existence. By about 1910 the two tests which are now known as the "heavy intermittent" and the "light intermittent" tests came into rather general use by several of the larger manufacturers. Within the last few years the demand for dry cells for radio "A" circuits has brought into existence two other intermittent tests, which have been standardised as the "heavy radio" test and the "light radio" test. Their use is in general, however, limited to the cells specially designed for radio "A" work.

The earliest flashlight cell capacity tests consisted in discharging the cells continuously through miniature lamps until they became dim. Lamp tests of this character were soon recognised in most quarters as being unreliable and inaccurate, and were superseded by continuous tests through fixed resistances. Lamp tests continued to be used in some quarters, however, until recent years, and even now are sometimes employed in laboratories not equipped to make the more accurate tests. The resistance used in the continuous test was at first 4 ohms and the cut-off voltage 1 volt per cell.

These values were based on the resistance and minimum satisfactory voltage of the carbon filament lamps then in use. Tungsten filament lamps induced a change to a resistance of 2·75 ohms and a cut-off voltage of 0·50 volt per cell. Quite recently the characteristics of miniature lamps have been somewhat modified, and this, together with the recognition of the fact that the continuous test was chiefly useful as representing heavy industrial service where a 0·5 volt cut-off is entirely too low, has brought about a return to a resistance of 4 ohms and a new cut-off of ·075 volt per cell. In this form the continuous flashlight test is being proposed for adoption by the American Engineering Standards Committee. Intermittent tests for flashlight batteries date back nearly as far as the continuous tests through fixed resistances. The one which has survived and is now practically standard discharges the cell five minutes daily through a 4 ohm resistance to a cut-off of 0·75 volt per cell and is considered to represent household flashlight service.

Service tests for "B" batteries are, of course, of rather recent origin, and no changes have occurred since their inception. There is a continuous test in which a 22·5-volt "B" battery unit is discharged through 5000 ohms to a cut-off of 17 volts. There are two intermittent tests, one of which employs a resistance of 5000 ohms and the other 1250 ohms per 22·5-volt unit, using the same cut-off voltage as the continuous test and discharged four hours daily.

The development of the dry cell from a quality standpoint has been stimulated by keen competition among the various manufacturers, and by outside competition of power devices, such as magnetos, bell-ringing transformers, and in the radio field, "A" and "B" eliminators. Practically all manufacturers keep informed on the quality of their competitors' products through periodic tests of cells and batteries bought on the open market.

The principal manufacturers maintain laboratories, the principal function of which is to better the quality of their product. One of the largest and best equipped research laboratories in the country is maintained by a dry cell manufacturer, and its annual cost of operation runs well up into six figures. The work of such laboratories is kept secret, and the results applied only to that manufacturer's product. Consequently, we have no published literature on the subject to which the industry can refer for guidance. But despite this lack of general information on quality matters, the industry has advanced steadily in this respect, though possibly at not as fast a rate as might have been possible through the pooling of information.

It is difficult to obtain an accurate measure of the quality improvement prior to about 1910, because prior to that time the tests which are now standard were not in general use, and it is difficult to interpret the early tests in terms of the present ones. An attempt has been made, however, to show in Tables II., III. and IV., the improvement

TABLE II.—*Quality Progress of "Standard" 6in. (15·2 cm.) Dry Cell.*

Date	Type of cell.	Initial short-circuit amp.	Shelf deter. in 6 mo., per cent.	Service capacity tests. Heavy inter. hours.	Light inter. days.	Heavy radio hours.	Light radio hours.
1901	General ..	16	35	—	—	—	—
1910	Ignition ..	24	20	40	130	—	—
1916	Ignition ..	27	25	35	140	—	—
1926	Ignition ..	35	10	60	180	85	210
1926	Radio "A"	35	10	70	180	115	260
1926	Telephone	24	15	50	230	—	—

TABLE III.—*Quality Progress of Flashlight Cells.* Size 1¼in. by 2¼in. or 3·2 cm. by 5·7 cm.

Year.	Shelf deter. in 6 mo., per cent.	Service capacity tests. 4 ohms continuous min. to 0·75 v.	4 ohms intermittent min. to 0·75 v.
1910	60	170	260
1916	30	325	380
1926	25	425	550

TABLE IV.—*Quality Progress of Radio "B" Batteries.* Size 1¼in. by 2¼in., or 3·2 cm. by 5·7 cm.

Year.	Shelf deter. in 12 mo. 5000 ohms cont. per cent.	Service capacity tests. 5000 ohms. continuous hours.	5000 ohms intermittent hours.
1923	45	680	750
1926	5	1000	1050

which has taken place, presenting data separately for standard dry cells, flashlight cells, and "B" batteries. The figures given do not represent the product of any one manufacturer, not yet the average for the trade as a whole, but have been selected as typical of the better and commercially more important brands. During the past ten years the tendency has been for more and more manufacturers to approach the higher quality standards, while the number of stragglers continually decreased.

In ampèrage there has been a steady climb as a result of the demands of the trade for a high-ampèrage cell, in spite of the fact that it has no bearing on capacity or dependability, except in the case of the telephone type, where high ampèrage is not generally considered a requisite. In shelf deterioration likewise there has been a steady improvement. In the heavy and light intermittent service tests, the data do not extend back beyond 1910, but since then there has been a decided improvement. The heavy intermittent test has been emphasised in the radio "A" type especially. The light intermittent test, which has always been considered as representative of telephone service, has been especially emphasised in the telephone type of cell. It will be noted that the 1916 figures show a temporary decline in quality, both in shelf life and heavy intermittent service. This occurred during the war period, when the battery manufacturers were compelled to resort to inferior materials, especially manganese ore.

In the flashlight branch of the industry there has likewise been a marked improvement in quality. Shelf deterioration and service capacity have both improved in a remarkable degree.

The radio "B" battery, being the youngest of the battery family, has, nevertheless, shown as great improvement in its few years of existence as the 6in. and flashlight types in the past ten years. This is no doubt the result of unusual attention bestowed upon it, because of its enormous commercial importance.

The figures in the accompanying tables fail to show the element of dependability, which is a factor of extreme importance from a quality standpoint. The dry cell has not yet completely recovered from a reputation, in the early days fully justified, that it was undependable and might fail, unexpectedly at any time and without apparent reason, though the development of internal defects. Much effort has been devoted by the manufacturers in the elimination of internal defects, and a tremendous improvement has been the result.

The dry cell as manufactured by the more progressive makers to-day is reliable to a very high degree, and the chances of such a cell failing through its own fault have been reduced to practically zero. This has been made possible through intelligent and exacting care in the selection of raw materials, close control of manufacturing methods and processes, and intelligent and accurate testing of the product before shipment. All these have been emphasised to a remarkable degree by the more progressive manufacturers, and the results have been extremely gratifying.

The Institution of Civil Engineers.

APRIL EXAMINATIONS, 1927.

PASS LIST (*INTERIM*).

(*Subject to confirmation by the Council.*)

The results of the examination held abroad will be announced later.

Preliminary (93).—L. H. Adam, J. C. Aldous, R. F. Alexander, A. E. M. M. Azmy, S. G. Barrett, D. K. M. Barron, R. W. Bassil, H. G. Bell, H. Bewick, S. H. B. Bird, W. R. Birks, P. A. W. Bolton, A. Borlase, W. C. N. Bosworth, A. H. Bowhill, F. G. Bray, W. Brown, G. W. Bruce, G. E. E. Buchner, K. A. Cole, A. H. Davies, F. Dawson, G. A. Evans, A. S. Fairn, L. C. S. Farmer, J. W. Fenton, J. B. Footner, W. Forbes, A. C. U. Forrest, G. J. L. Forrest, E. W. Geary, B. T. Good, E. Graham, L. J. Grimshaw, R. J. Gurney, P. E. Haines, C. H. Hales, W. P. Hall, T. G. Hand, S. C. Hardern, E. D. Head, C. C. B. Herbert, G. Hogg, R. V. T. Hoskings, W. L. Houlbrook, H. C. Jenkinson, W. Keen, W. G. King, J. D. Knowles, J. McIndoe, E. Mattinson, M. Midgley, W. Morris, J. Mulgrew, J. Nicholson, R. S. Norrish, S. J. O'Farrell, J. S. Orchard, C. A. Pass, F. R. Paynter, J. F. M. Perrott, E. Perry, J. M. Ramsay, K. R. Reavley, L. F. B. Reeves, P. Reilly, R. Richards, J. L. Ringrose, C. Rose, S. J. D. Russell, H. W. Sanders, R. H. Shepherd, B. G. Skingle, F. G. Smith, J. G. Smith, R. R. Somerset, M. A. Speir, J. R. H. Spencer, T. Spowart, T. J. Sweetnam, W. S. Tait, C. G. Thompson, W. F. Tunks, J. Turnbull, S. E. Van Ryssen, J. S. Vigne, D. C. Wadhwa, K. Wahba, I. G. Watson, W. M. Wilby, A. J. Wilson, A. G. Wilson, J. Young.

Associate Membership (253).—*Whole Examination* (*Sections A, B and C* (7).—H. A. F. Canfield, C. W. Cassé, F. P. Dyson, G. C. W. Hurry, J. W. Moncur, W. F. Wegener, F. Wood.

Sections A and B only (21).—A. A. Abdeldayem, J. Chrystal, B. Donkin, A. J. Dow, A. H. A. Draz, R. F. Earley, H. R. Farrington, R. G. Gallien, J. E. R. Hollingworth, H. M. Horrocks, L. Jefferies, J. B. Lund, D. G. Mead, R. N. Pegg, R. S. Rendle, A. G. Richardson, J. Shaw, G. Smellie, W. Strother, G. M. Wheat, L. J. Wyatt.

Sections A and C only (1).—E. Sykes.

Sections B and C only (12).—L. Bendelow, H. S. Boyes, H. Davies, A. A. Doig, W. A. Doig, R. S. B. Hervey, J. Holt, J. E. Johnson, J. A. Johnston, M. H. Limb, R. E. Sadler, J. M. Simpson.

Section A only (33).—W. E. L. Adams, W. G. Beeson, G. R. Bennett, N. B. Bennett, A. F. Benson, C. H. Bradbury, S. P. de Laszlo, R. Elliott, D. R. Errington, A. H. Freeman, J. McP. Gordon, N. B. Hodgkin, R. A. Hutson, A. Inglis, W. M. Law, C. Lunn, J. Mackie, K. B. Manning, S. F. Morice, N. J. Pugh, A. A. Ragg, K. Seymour, F. B. Smith, E. R. Stables, M. W. Summers, B. W. Sutherns, F. W. Taylor, C. E. H. Verity, J. P. Walton, R. J. Williams, T. F. R. Wilson, W. O. Wright, D. F. Young.

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Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Conditions.

TRADE in engineering circles in the Midlands and Staffordshire remains unsatisfactory, being patchy and unreliable. Under these circumstances it is not surprising to find little interest being taken in the raw material market. To-day's meeting of the Midland iron trade in Birmingham was only moderately attended, little business was stirring, and prices remained much the same as a week ago. There was increased weakness in the raw iron department, smelters shading quotations where desirable business was offered. In no branch in the iron and steel trades was there any disposition to place forward contracts, and the hand-to-mouth business transacted was inconsiderable. Work has now been resumed at most of the Black Country works, but there is still a large proportion of inactive plant, and the material required does not amount to much. Staffordshire re-rollers are very badly off for work, and many of the mills and forges are working only intermittently. The market is yet some way from pessimism, however, hopes of better business in the near future being expressed by many prominent Midland industrialists.

Finished Iron.

Ironmasters who anticipated an increase in business as a result of the reduction of the price of marked bars have so far been disappointed. It is, of course, early yet and the Whitsuntide holidays, having in many cases lasted the whole of last week, have helped to make demand quiet all round. Up to the present, however, the lowering of prices has made little difference to the demand, and works are poorly employed. Indeed, the state of Staffordshire ironmasters' books is indicated by the statement made this week that many of them would be glad to accept appreciably lower prices if by so doing they could get full employment and straightforward runs for the mills. Current orders are so small and multifarious that production costs are proportionately extremely high. It is this difficulty which has to be faced in seeking a new basis of prices such as will give some assurance of stability upon which to rebuild the iron trade. Not only is the demand for marked iron small but demand in the other branches of the Staffordshire bar iron trade continues poor. A fair amount of specially made iron is going into the anchor, chain and cable industries, but that is about all. Every bit of business which comes into the market is keenly competed for, and Lancashire mills that have been quoting £11 for Crown bars for this market are now ready to accept £10 15s. This brings Lancashire bars to equality with another outside make which has been offered at £10 15s. for some little time past. Iron strip can now be bought at £12 upwards. Though there is little being done in native materials, quantities of continental material are being delivered in the district, including nut and bolt making iron, at about £6. Semi-finished material, such as sheet bars, costs £5 12s. 6d.

Pig Iron.

The inquiry for pig iron continues poor, despite the recently reduced prices. Some smelters are feeling severely the withholding of business. No definite news of the damping down of Midland furnaces is yet to hand, but the question is one that is under consideration owing to the lack of demand. Local pig irons continue on the down grade, and such transactions as are put through are at cut prices. The efforts of furnacemen to steady values at the point to which they receded a week ago have proved ineffectual. Supplies are greatly in excess of demand, and so much of the output is unsold that smelters are anxious to secure orders to help them to carry on till the autumn demand comes along. For anything like substantial tonnages some Derbyshire smelters are reported to have accepted £3 10s. for No. 3 foundry iron. This is the figure which consumers a week ago offered to pay for that class of material, and it would appear their offers have been accepted after consultation of representatives and the heads of firms. Most of the furnaces, however, still quote £3 12s. 6d. Northamptonshire No. 3 has changed hands at £3 5s. on rail. On 'Change in Birmingham to-day it was stated that business had been done in Northamptonshire forge at a little over £3.

Steel.

Buying is very quiet in the steel department, and now that arrears of orders have been overtaken, there is danger of stocks accumulating at makers' works. Steel is being absorbed only in small quantities, and constructional engineers, who can now get prompt supplies, buy only for immediate requirements. In no department is there any sign of a return to forward contraction. Despite the fact that continental competition in both finished and semi-finished materials is keen native makers maintain recent quotations. They claim that the basis of £7 12s. 6d. for sections is not remunerative under existing conditions. There is a slightly easier tendency in small bar and billet prices. Though quotations are unchanged, it is held that some sellers have shaded the £8 and £7 basis for bars and billets respectively. Demand for plates continues fairly good, and makers experience no difficulty in getting £8 7s. 6d. for ship, bridge and tank plates, and £11 upwards for boiler-plates. Calls from the engineering trade generally are spasmodic. While some firms are still able to use all their resources, others less fortunate find business disappointing. Engineers, heavy or light, can only see a little ahead. Inquiries appear to indicate that there is now some chance of schemes which have been deferred for long periods, awaiting favourable conditions, being put in hand. Until contracts are actually placed, however, engineers will continue to purchase material only as it is required for service. Railway electrification has been providing a welcome employment in the Birmingham district.

Galvanised Sheets.

Galvanised sheet mills are receiving a steady inquiry for material, prices continue easy at £14 12s. 6d. to £14 15s. for corrugated sheets of 24-gauge. India continues a good customer for thick gauges, while Central and South America, Australia, and the West Indies are also customers.

Rolling Stock.

The railway carriage and wagon industry in the Midlands is not so well off for orders as it has been for the past six months, and there is now insufficient work on hand to employ all its resources. Most of the big establishments in this area are fairly well off for the present, however. There is a substantial balance of old contracts yet to be completed, the effects of the interruption of supplies during the coal stoppage being apparent still. The outlook is not over good. In the present state of railway finance rolling stock makers cannot expect very much from the home demand yet awhile. There are, however, some encouraging signs of enterprise in various directions abroad. But new business does not materialise very fast. There is keen competition for such orders as are going, especially from Belgian, German, and other continental makers.

Coventry Industry.

Trade in Coventry, which should now be at its best, is only to be described as uneven, and in view of the uneasiness existing in so many quarters there seems little prospect of it settling down. In the engineering industry itself the application of the various unions for a wage advance still hangs overhead, and local conditions certainly support the view of the employers generally that the industry cannot stand any additional burden. Motor engineering firms are looking forward to fairly substantial business during the summer months, but the season is likely to be far from a record, for, while many car firms have been kept busy, others have been only moderately well employed. Makers of heavy transport vehicles report very favourable conditions and prospects, a regular trade being fairly well assured. Stampers and drop-forgers are finding things quiet, but machine tool works have pretty well of business on hand.

Foundry Trade.

Midland foundrymen are very badly off for orders although prices have been reduced to practically the pre-strike level. Competition for business is extremely keen, and unassociated firms are already exercising their freedom to quote for business at cut rates. They are not yet able to buy pig iron on terms as favourable as those which prevailed prior to the upheaval last year, but foundry coke is now almost down to the figure at which it stood in April of last year, so that founders are really well placed, and only need an increased demand to put them on a good trade footing.

Production Figures.

Though it is deplorable to find that during the month of May five blast-furnaces have been damped down or blown out in the Kingdom, bringing the number of active furnaces down to 184, it is satisfactory to note that the output of pig iron for May shows improvement on that of the previous month, being 720,100 tons, compared with 680,000 tons in April, and 88,800 tons in May, 1926, the first month of the coal stoppage. The production of steel ingots and castings in May, it is noted, showed a slight falling off, amounting to 832,500 tons, compared with 850,100 tons in April and 45,700 tons in May, 1926.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Industrial Results.

Two interesting reports of Manchester companies —John Hetherington and Sons, Ltd., textile machinists, and Richard Johnson, Clapham and Morris, Ltd., iron and steel merchants—have been issued within the last day or two. That of Messrs. Hetherington and Sons covers the period of twenty-one months ending March 31st last, and discloses a net profit, after allowing £27,125 for depreciation, of £35,691. The report states that during the period of enforced quietness as a result of the coal stoppage advantage was taken to carry out a scheme of reorganisation and concentration of the plant. This is now on the point of completion, and it is estimated that as a result of these measures an annual saving of at least £30,000 will be effected, while a substantial benefit is already being felt. The works are in shape for executing extensive orders now on the books, in particular one for artificial silk machinery amounting to £361,500. This new branch of manufacture, it is the confident belief of the directors, will prove a great source of strength in the future. The financial results of Messrs. Johnson, Clapham and Morris show a marked improvement for the year ended March last, compared with either of the two preceding years. The net profit was £20,077, against £5202 in the previous twelve months and a loss of £7459 in the year 1924–25, and an ordinary dividend of 3¼ per cent. is being paid, no distribution on these shares having been made in the two preceding years.

Non-ferrous Metals.

In no section of the market for non-ferrous metals during the past week has there been any particularly striking feature, and although all of them, with the exception of spelter, have given way compared with the prices current a week ago, the declines have not been of very serious consequence, the fall in lead being relatively the most severe. The demand for tin from home consumers has remained quiet, although there has been a fair amount of buying on American account. This, however, was not sufficient to prevent a substantial decline at one period, a recovery from the worst being effected on the strength of a reduction in the spot supplies of the metal at English ports. In the case of copper, whilst cable makers in this country have been placing a fair weight of business, inquiry from continental users has been slow, and keen competition from outside sellers resulted in a net fall of several shillings compared with last week's prices. The demand for lead has been restricted, and with abundant supplies on offer a reduction of about 15s. per ton has taken place. With a fair inquiry for spelter on occasions, values in this section of the market have continued steady, and on balance are rather higher than they were at last report.

Iron.

Conditions in the pig iron market seem to be approaching a critical stage. Up to the time of writing there has been no real recovery after the holiday flatness, and it is probable that until the beginning of next week even the very moderate standard of buying that obtained before the Whitsuntide break will not be regained. Marked weakness is still in evidence, particularly in respect of Staffordshire and Derbyshire brands of common irons, and unless there is an early improvement in the volume of buying, a damping down of furnaces as an alternative to excessive stocking of pig iron will be unavoidable. For delivery into this area Staffordshire makers are now quoting at about 79s. 6d. per ton, with Derbyshire iron offered at 79s., but in neither case are the figures mentioned rigidly adhered to as minima. Middlesbrough makes for delivery here remain at the quotation of the last few weeks —about 83s. per ton—but Scottish No. 3 and East and West Coast hematites are somewhat easier at 97s. 6d. and 92s. 6d. per ton respectively. An extremely unsatisfactory position still obtains in the market for finished iron, and Lancashire bar iron makers are meeting with a very poor demand. Crown bars are on offer at £11 per ton and second qualities at £10.

Steel.

In steel also buyers are exercising considerable caution, and forward commitments are virtually negligible, small orders for prompt or early delivery constituting the bulk of the business that is being currently put through. So far there has been no modification of the Association minimum prices for ship plates and sections, although it is reported that parcels in second hands are in some instances selling at something less than the fixed figures. It is certain that until an appreciable reduction in makers' quotations becomes operative there will be no forward buying on anything approaching a normal scale. Boiler plates are being offered at £11 5s. per ton, ship and tank plates at £8 7s. 6d., joists and sections at £7 12s. 6d., and bars at from £8 2s. 6d. to £8 15s. Little interest is now being shown by Indian buyers of galvanised sheets, and although 24 gauges are still quoted at about £14 12s. 6d. per ton f.o.b., the tone is decidedly weak. With the exception of wire rods, which are slightly steadier, most varieties of imported steel materials have given way a little, and the demand all round is on quiet lines. Ordinary plates are being offered at from £7 to £7 2s. 6d., Siemens plates at about £7 7s. 6d., joists at £5 15s. to £5 17s. 6d., billets at £5 5s., and sheet bars at about £5 10s. per ton, for cash against shipping documents and including delivery to users' works in Lancashire.

Scrap.

Buying of non-ferrous metal scrap is slow at the moment, but values are fairly steady at £24 to £25 for scrap lead, £23 to £24 for zinc, £52 to £52 10s. for selected gunmetal scrap, £56 to £57 for clean light copper, and £44 to £45 for heavy yellow brass, for graded qualities, and including delivery to buyers' works.

BARROW-IN-FURNESS.

Hematite.

The position in the West Coast hematite pig iron market is such as to cause a slight feeling, let us hope momentary, of depression. The reduction in the price of iron which has been made has plainly not tempted customers as yet. Orders which are being received are not for heavy tonnages, and it would appear that consumers are still holding off from placing orders for future delivery until the price of iron is such as to permit their obtaining a small margin on contracts. Another furnace has gone out at Cleator Moor in Cumberland, and it is very evident that makers are carefully watching the market so as to escape the accumulation of stocks. This attitude might seem to suggest that makers are avoiding making stocks, being of the opinion that it is unwise to stock iron at the present costs when there is a possibility of production becoming cheaper. A lot depends upon the price of coke. The present charges for East Coast coke delivered in this district are, in the opinion of many, still too high to give the iron trade a chance. A lot of iron at present being turned out from the furnaces is being taken by the steel departments. The local iron ore trade is naturally affected by the reduction of the number of furnaces in blast, and output has naturally been reduced, the mines not carrying stocks to any marked extent. Imports of ore from various sources are also restricted to some extent. The steel trade is quiet, and makers are gradually getting through their orders. Unless fresh contracts come to hand in the early future, there will certainly be some serious interruptions in these departments. This remark does not apply to the hoop ore small section mills at Barrow, which are well situated as regards contracts.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trade.

CONDITIONS here remain practically unaltered. The uncertainty that has prevailed for some time has not been removed, so that the danger still exists that production may have to be curtailed. The open-hearth furnaces are producing more steel than they can sell. The conclusion of the Whitsuntide holidays did not find any appreciable increase in the amount of buying. Everybody seems inclined to wait for a complete stabilisation of market conditions before placing big forward business. Interest therefore naturally centres at the moment on prices. Iron and steel quotations are weak, but there is no quotable change beyond those I have noted during the past few weeks. The market for blast-furnace coke has slumped badly, and with individual makers coming to their own terms with customers, there is naturally diversity in the quotations. On the Sheffield Exchange last week the figure of 14s. per ton at the ovens was mentioned, but I hear of a case in which coke has been sold at 12s. 6d. per ton. This is a remarkably low figure, being less than the pre-stoppage figure by 1s. 3d., and, indeed, only 6d. more than the average local pre-war quotation. The rolling mills are finding that work is of an irregular character. Heavy foundry work is scarce, as it has been for a long time, but there is a steady call for small steel castings. The ironfoundries could accommodate a good deal more work on the whole, but there are some firms which are doing well on special contracts, and will have a busy time for some months.

A Russian Order.

In view of the doubts in trading circles as to what will happen to Russian business as a result of the recent rupture, it is extremely interesting to learn of one Sheffield order at least that is not to be cancelled. Shortly before the break with the Soviet, Watsons (Metallurgists), Ltd., of Sheffield, received an order for a Greaves-Etchells type of electric steel furnace of 3 tons capacity, to be erected at Ekaterinaslav for the production of tool and special steels, and it is now reported that the trouble between the two Governments will not be allowed to interfere with the execution of this contract. This firm has also several other foreign orders for furnaces on hand. For steel works at Melbourne, where one furnace has been operating for some time, another of 1-ton capacity is being supplied, and is intended for use in the production of steel castings. A third contract has been placed by a Spanish company, already operating several of these furnaces, for one of 1-ton capacity to be used for melting special steels. Considerable significance can be read into the last transaction, in view of the heavy duty that the Spanish Government has recently imposed on special steels coming into Spain. It suggests that Spain is developing its own resources for the supply of tool steels.

Engineering Orders.

It is announced that the Hunslet Engine Company, Ltd., Leeds, has received from the London, Midland and Scottish Railway Company a further order for twenty-five tank locomotives, similar to the series of fifty engines completed last year by the Hunslet Company, together with the Vulcan Foundry, Ltd., and the North British Locomotive Company, Ltd. These engines are of the six-wheel coupled, side tank type, and their work is mostly that of shunting and of dealing with ordinary traffic on short branch lines. They weigh only 50 tons each and can draw heavy loads and yet are easily handled. The Frodingham Iron and Steel Company, Ltd., has secured an order from the London County Council for the supply of steel conductor tram rails for the coming twelve months. The Sheffield works of Metropolitan-Vickers Electrical Company, Ltd., will share in the important contracts, valued at nearly £250,000, which have been placed with them in connection with the Liverpool power supply extensions.

Tool Trades.

The tool trades are passing through an uneasy time. Orders are arriving irregularly, and prices are being so finely cut that transactions are not proving any too profitable. The file factories are working short time in the main, and there is no doubt that the absence of Russian business is making a difference. In past years it has been the custom to place fair orders for files, saws and edge tools with Sheffield firms, and in the ordinary run of things these would have been allotted by now in order that the work could be delivered before the closing of the Russian ports by ice. The work, however, has not been placed, no doubt as a result of the recent severance of relations, and it is impossible to say how things will develop. One thing that seems pretty certain is that a certain amount of trade will be lost this year at least.

Cutlery and Plate.

Since the holidays very little work has been done in the plate and cutlery factories, and a good many hands have been suspended until trade improves sufficiently to justify their reinstatement. Output is believed to be less than for a long time past, and there is hardly any business coming through the normal trade channels. One of the chief branches in which trade has fallen off is that of stainless knives. Scissors, ordinary razors and pen and pocket knives are commanding an indifferent sale, and in some cutlery lines serious competition is being met with from Germany. A Government contract for a thousand gross of hacksaw blades has been given out. Apart from special contracts, no large business is being placed for electro-plated ware. The retail houses nowadays are content to buy in small parcels only, not a very satisfactory system for manufacturers working on sharply cut rates.

Gas-cleaning Plant.

The Staveley Coal and Iron Company has just put into operation at its Devonshire works a large gas-cleaning plant, the parts of which have been mainly supplied by Markham and Co., Ltd., Chesterfield. The plant is designed to deal with 4,500,000 cubic feet of blast-furnace gas per hour, and to reduce the extremely fine suspended dust from the furnaces to a negligible amount. It is one of the few plants of its kind in the country. The effect of cleaning is to keep the stoves and the blast-furnace gas mains, of which there are 3200ft., clean, thus giving greater efficiency and economy.

Mines Research Station.

The Safety in Mines Research Board's new experimental station at Harpur Hill, near Buxton, was opened this week. This station supersedes that at Eskmeals, in Cumberland, and the £35,000 expended on its erection and equipment has been found by the Miners' Welfare Fund. It is proposed to spend £50,000 annually on research work. The chief experiments will relate to firedamp and coal-dust explosions, and "gob" fires. The explosibility of coal dust under varying conditions is tested in three galleries, resembling iron pipes, the longest of which is 1000ft. by 4ft. diameter. This gallery is equipped with instrument cabins every 100ft., the object being to measure the rate at which an explosion flame travels and the pressure produced by an explosion. Another gallery, 100ft. in length and 7½ft. in diameter, has been constructed to measure the distance to which the flame of an explosive may be projected along a roadway beyond the area originally occupied by the explosive mixture. Restrictions in the path of a flame will be placed in the third gallery, so that any effect thus caused on the speed of the flame may be studied. In everything at the station endeavour has been made to obtain conditions approximating those of an actual mine. Many other investigations will be carried on when the station is in full working order.

NORTH OF ENGLAND.

(From our own Correspondent.)

Serious Coal Trade Outlook.

A SERIOUS view is being taken in the Northumberland and Durham coalfields of the French Government's coal decree. Except for a spasmodic but unreal revival following the cessation of the strike, the coal trade has been in a parlous condition ever since. With prices back to the pre-war level, the production costs nearly 50 per cent. above those of 1914, the plight of the coalowners will be readily realised. On top of all comes the decree prohibiting the importation of coal into France except under licence. It is possible, of course, that there may be some modification in practice of the stringency of the order, owing partly to the fact that it is being opposed in certain quarters in France itself, and partly to the fact that the British Government is interesting itself in the matter. In the meantime exporters in this area are showing considerable anxiety, and the present cancelling of contracts can only mean throwing thousands more miners out of work. Some of the large coal exporters expect to get permits for coal bought for lighting and other undertakings, but news of licences having been actually secured is not to hand. It is reported that Durham coals may be limited to 10 or 15 per cent. of the usual quantity shipped from this county. On the other hand, there are more hopeful estimates that, as soon as France has absorbed a surplus of about two million tons of coal, which is now on the ground, licences will be granted more rapidly. Advices received in this area intimate that French importers, staithowners, and shipowners are keen to support the exporters in this country, because a severe curtailment of coal shipments will mean a disorganisation of port labour and traffic in France, and much unemployment.

Cleveland Iron Trade.

While indications of real movement in the direction of revival of business in the Cleveland pig iron trade are still absent, a slightly more hopeful feeling prevails. Continental prices of ordinary foundry iron are distinctly firmer, and this fact, coupled with the recent fall in Cleveland prices, has virtually stopped the purchase or foreign iron by local consumers who now find it more profitable to use Cleveland iron. In Scotland, however, the continental producer can still successfully compete, and only small orders are coming to Cleveland makers from across the Border. Still, the traffic between Cleveland and Grangemouth is increasing, and with a few more export orders coming to hand the Cleveland makers are getting rid of most of their current output. Of course, what producers would really like is a good order book over the summer months, but there is still no talk of forward contracts, and it consequently remains uncertain whether employment can be found for the whole of the plant at present in operation. Quotations for most commodities are unremunerative, and, as customers are seeking further price concessions, producers are in the unfortunate position of being faced with having to increase their losses by again lowering rates or by laying more plant idle. With little or no prospect of early relief by a material fall in the cost of output, makers fear that they may be compelled to adopt the latter course. No. 1 Cleveland pig iron is 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d.

Hematite Pig Iron.

Conditions in the East Coast hematite pig iron trade are slightly better. Output has shrunk to a level that inspires a hope of stocks being reduced. Further small business with Italy is reported; moderate contracts are understood to have been arranged with South Wales consumers; and customers in the Sheffield district are buying a few lots of iron. Small parcels of mixed numbers can be bought at 77s. 6d.; whilst for bigger orders that price can be shaded. No. 1 grade is at a premium of 6d. per ton.

Foreign Ferro-Manganese Imported.

Producers of ferro-manganese in the Cleveland area have hitherto met the requirements of the North of England for that commodity, but the market has now been invaded from abroad, and a cargo of a hundred tons from Sanda has been discharged this week in the Tees. The import is a small one, but some importance is attached to the incident, as, up to the present, manufacturers here have kept overseas producers out by supplying consumers on as low terms as the commodity was purchasable at from abroad.

Iron-making Materials.

New business in the foreign ore trade is unheard of, but imports against contracts made a while ago continue heavy, and consumers' stocks are large and increasing. Best Rubio ore is still nominally 22s. per ton c.i.f. Tees. The fuel market shows no substantial change, but iron-masters are hoping to get supplies of Durham furnace coke at less than 21s. 6d. per ton delivered at the works, which is the figure now quoted.

Manufactured Iron and Steel.

The manufactured iron and steel trade presents few new features. Orders are only coming along slowly. There is a fair amount of work in hand at most of the works, but the productive capacity is so great that a continuous flow of orders is necessary to keep the plants fully employed, and of late output has exceeded the volume of contracts secured. Hence, the outlook is not bright for the Northern steel trade, which so largely depends upon shipbuilding activity for its prosperity. Prices are unchanged.

The Coal Trade.

There is hardly any movement in the Northern coal trade. Inquiries are of a limited character and mostly for odd cargoes. The forward outlook is very disquieting, but producers are not making any price concessions at present, and are not likely to go any lower in face of the high cost of production. For the first time for many weeks the steam coal position shows a steadier tone, and best Northumberland steams have changed hands through contractors at 14s. 6d. Fitters report a well booked position to the end of the month, and are quoting freely but firmly at 14s. 6d. for this month or early July. Production at many pits has been curtailed, and, of course, the annual holidays next week will further limit output. Best Durham steams are steady at 17s. for large and 12s. 6d. for smalls. The Durham gas coal trade is irregular, but fitters hold steadily. Supplies, however, remain plentiful. Best grades are quoted at 16s. 6d. to 17s. Durham coking unscreened coals are abundant, and weakly held owing to the uncertain French demand. Business moves slowly at 14s. to 14s. 6d. Durham unscreened bunkers are steady at 14s. for ordinary and 14s. 6d. to 15s. 6d. for best qualities. The demand for gas coke is brisk for this month, and makers' output is fully sold, and in several cases stocks are having to be drawn upon to fulfil this month's bookings. Prices are steady at 19s. 6d. Foundry and furnace cokes are irregular and in ample supply. Good ordinary patent cokes are 20s. to 22s.; special makes, 25s. to 28s.; and beehive, 30s. to 35s.

SCOTLAND.

(From our own Correspondent.)

Continued Depression.

CONDITIONS in the steel, iron and coal industries have not changed during the past week, and the depression in all departments is more acute. Prices on the whole are easy, and always contain the possibility of weakness under present conditions, while the general state of affairs is emphasised by the fact that in many instances the prices current are barely remunerative. Manufacturers may determine to resist reductions in prices, but meanwhile the works are slowly but surely becoming less active, and have small prospects of a change for the better.

The Coal Embargo.

The French embargo is naturally causing considerable anxiety in Scottish coal circles. While the quantity of coal exported to France is not extensive, the exporting districts cannot afford to lose any source of disposal at present, or, in fact, at any time. Further, it is recognised that those districts most severely influenced by the embargo must, of necessity, become keen competitors in other markets. Shipping circles in Glasgow are most adversely affected by the suspension of the French export trade.

Steel and Iron.

Steel prices are being maintained at the agreed minima, even in the face of poor bookings and depleted order books. Makers are determined to resist reductions beyond a certain point, but with a continued scarcity of orders, further concessions would appear almost the only alternative to closing down pending an improvement in trade. Many establishments have now overtaken arrears of work, and new business is not forthcoming in sufficient volume to maintain the recent rate of output. Much was expected from the increase in orders placed with shipbuilding firms in the district, but such hopes have not yet been realised, as progress at the shipyards has been slow. The orders will probably be forthcoming in time, but the steel and iron works may have a lean time in the interval. Malleable bar iron works continue to seek business, but have not received much encouragement, despite price reductions. A similar state of affairs exists in the steel re-rolling departments. Re-rolled steel bars are quoted £8 2s. 6d. per ton for home delivery, and about £7 17s. 6d. per ton for export, but the latter price is becoming very elastic.

Steel Sheets.

Higher grade qualities of black and galvanised sheets have sold well for delivery over the next six weeks. It is said that export merchants have endeavoured to depress the market, but that makers have declined to follow the movement.

Pig Iron.

The amount of business passing in pig iron at present may almost be termed trivial. Orders are small, and competition keen. Stocks are accumulating, and the tone of the market is weakening.

Coal.

All branches of the coal trade are dull and depressed. Orders from all sources are most unsatisfactory, and outputs are being still further reduced. A number of pits producing splint coal have been closed down, causing a substantial decrease in available supplies and a hardening in the price to 17s. per ton for best qualities. Practically all large coals are poorly placed, and treble nuts remain the firm feature of the market in all districts. Aggregate shipments amounted to 234,269 tons, against 252,490 tons in the preceding week and 192,730 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

COMPLAINTS are very general regarding the quietness of the coal export trade. The conditions certainly leave a good deal of room for improvement, as numerous collieries are working short time, and there is little prospect of an immediate alteration. At the end of last week there were as many as thirty-eight idle loading berths at the various docks, but the position on Monday was better, as the result of the arrival of tonnage during the week-end, there being only fifteen idle appliances. Still, it is unlikely that trade will show any real advance for some little time, and the fact that last week the amount of tonnage taken up for loading in this district was over 100,000 tons less than during the previous week, shows that shipment operations will, temporarily at least, be on a restricted scale. However, last week was more or less a holiday period, and it was not to be expected that chartering operations would be up to the average; while, furthermore, the returns regarding coal exports and imports of various commodities were below the figures of previous weeks. For the week ended the 10th inst. coal exports came to only 354,000 tons, as against over 460,000 tons for the week ended the 3rd inst. The returns for the current week, however, should show an improvement upon last, though perhaps not up to the average. Unfortunately, the general inquiry from abroad is very meagre. The Belgian State Railways are in the market for 145,000 tons of large, through and small coals for delivery over July, August and September, but the view is held that the chances are that comparatively little of this business will come to South Wales. Apart from this, there is nothing outstanding in the market, which is quiet.

Coal to France.

There is still a certain amount of uncertainty as to the position regarding shipments to France under the system of coal import licences, though the air has been cleared to some extent, and feelings of genuine alarm which were at first entertained are giving way to the view that the conditions will not be as bad as was at first thought. In the first place, steamers which had been chartered are allowed to load, and firms which have contracts have now been informed that they can ship up to 60 and even 70 per cent. of their monthly quantities. They are now doing so, and, strange as it may seem, shipments to France are proceeding practically on normal lines. So far as certain business is concerned, no one would know that there has been any licence system brought into operation, but that is not to say that South Wales will not feel the effect of the innovation, as from all accounts the general idea of the French Government is to reduce the importation of external supplies by 30 per cent. If this reduction were to be imposed on every importer, it is plain that the Department dealing with the application of the scheme would have an enormous task. The detail work would be overwhelming. The result is that the authorities are reducing the monthly quantities of the coals contracted for by the French State Railways and the other big services, and are giving licences very freely to other importers of supplies for domestic purposes. The farther off importers are from the French coalfields the easier do they find it to get licences for shipment of coals from this country. Of course, coal exporters and coal-owners here are continuing their efforts to safeguard their interests, but it must be stated that so far there is no evidence available that the French authorities are taking advantage of the powers possessed to cut down contracts that have been entered into. Reduction in the shipment of the monthly quantity automatically means an extension of the period of delivery. It remains to be seen what will happen when the period of delivery originally arranged when contracts were made comes to an end. The report has been current that Germans who have substantial contracts with France have offered to reduce their prices provided that French importers are prepared to enter into fresh contracts for the supply of coals over 1928 at the same figure. There is so far no confirmation of this.

Pensions for Miners.

There appears to be a very strong desire on the part of coalowners and miners' leaders to push forward the idea of provision being made for pensions for miners. The suggestion has been made that a fraction of the Welfare Fund should be earmarked for that purpose. The new Industrial Union leaders, from all accounts, have committed themselves to this policy, and now the leaders of the South Wales Miners' Federation are anxious not to be behindhand, and contend that this was a matter taken up by them years ago, but that the stoppages which took place in the industry in 1921, 1924 and 1926 had retarded progress being made. The Executive Council of the South Wales Miners' Federation at a meeting last Saturday decided to ask the Miners' Federation of Great Britain Committee, in accordance with instructions given at the annual conference at Folkestone some years ago, to secure an actuarial report upon the possibilities of establishing a miners' pension scheme for presentation to the forthcoming annual conference of the National Federation.

Craftsmen's Wages.

When the representatives of the coalowners and the Craftsmen's delegates met last week to discuss the proposal of the coalowners that the subsistence wage should be decreased from 8s. 0½d. per shift to 6s. 10d., there was failure to agree, and it was decided to refer the matter to the arbitration of the independent chairman, and Sir Francis Taylor will therefore meet representatives of the two sides at Cardiff on the 17th inst.

Steel and Tin-plate Trades.

The conditions prevailing in the steel and tin-plate industries of this district cause some anxiety, especially in the West Wales area. It is estimated that only about 60 per cent. of the mills are operating. Several of the large tin-plate works are completely at a standstill. At Messrs. Richard Thomas's works at Llanelly only three furnaces are in commission. The British Mannesman Tube Works at Landore, which were rendered idle for several days consequent upon a breakdown in the main transmission, thus causing about 300 men to be idle, have now resumed operations. The Blaenavon Company's coke works, which have been idle for nearly two years, restarted last week and afford employment to about 100 additional men, which figure will be increased in the course of a week or so.

Current Business.

The tone of the steam coal market continues to be very dull on the whole. A few of the collieries are working very well, but the majority are having a difficult time, and stoppages are fairly numerous. The values prevailing are generally easier, though quotations are extremely irregular and are governed entirely by the individual position of collieries. Best Admiralty large coals are quoted at 21s. 6d. to 22s., and others in proportion, with dry qualities forming the easiest section of the market. Small coals are rather steadier in consequence of the number of stoppages taking place in the coalfield. Best smalls are quoted up to 14s. 6d., but sellers will take in some instances 6d. less if purchasers will at the same time buy a proportion of large coals. Coke and patent fuel remains without any material change, but there is not so much doing in pitwood, which is quoted round about 30s. 6d. to 31s.

INSTITUTION OF NAVAL ARCHITECTS.

THE preliminary programme for the summer meeting of the Institution of Naval Architects, which is to be held in Cambridge, is as follows:—

On Tuesday, July 12th, at 10 a.m. the meetings will be opened in the Senate House, when the following papers will be considered:—(1) Mr. G. S. Laird Clowes (Associate), "Shipbuilding in the Time of Pepys"; (2) Engineer-Commander J. C. Brand, R.A.N., "Pulverised Fuel for Marine Work"; and (3) Mr. F. H. Alexander (Member), "The Propulsive Efficiency of Rowing." In the afternoon there will be visits to colleges and in the evening a reception by the Vice-Chancellor of the University.

On the Wednesday there is to be an all-day visit to Bedford, where W. H. Allen, Sons and Co., Ltd., will entertain members at luncheon in the Queen's Engineering Works. In the evening there will be a reception in the Engineering Laboratories, Cambridge.

The Thursday morning will be devoted to the consideration of the following papers:—(4) Mr. G. S. Baker (Member of Council), "The Analysis of Screw Propeller Efficiency, with particular reference to Froude's Method"; (5) Mr. J. L. Kent (Member), "Average Sea Speeds under Winter Conditions"; and (6) Professor William Hovgaard (Member), "Deformation and Stress Distribution in Rigid Airships." In the afternoon there will be further visits to colleges and a garden party in King's College Gardens. In the evening the banquet of the Institution will be held in the Hall of Trinity College.

On Friday, July 15th, members will leave Cambridge, 9.20 a.m., and arrive Ipswich, 10.50 a.m., where they will be received and entertained by Reavell and Co., Ltd., the Manganese Bronze and Brass Company, Potters Ltd., and other members of the Reception Committee. The return to London will be from Ipswich.

Catalogues.

ALBION MOTOR CAR COMPANY, Ltd., Scotstoun, Glasgow.—Leaflet describing the Albion service for London and the South-Eastern counties.

SIR W. H. BAILEY AND CO., Ltd., Salford, Manchester.—Pamphlet No. 3326, describing high-speed, single-acting air compressors or vacuum pumps.

THE SUPERHEATER COMPANY, Ltd., 195, Strand, London, W.C. 2.—Pamphlet No. S. 3 on the M.L.S. bifurcated tube for furnace water wall construction.

THE CAMPBELL GAS ENGINE COMPANY, Ltd., 73A, Queen Victoria-street, E.C. 4.—Brochure entitled "The Price of Power," explaining the advantages of oil engine sets.

THE PREMIER ELECTRIC WELDING COMPANY, Ltd., Abbey Wood, London, S.E. 2.—Descriptions of electric arc welding plants including alternating-current welders.

THE CONSOLIDATED BRAKE AND ENGINEERING COMPANY, Ltd., Caxton House, Westminster, S.W. 1.—Brochure giving particulars of power brakes for road vehicles.

WELLMAN, SMITH OWEN ENGINEERING CORPORATION, Ltd., Victoria Station House, S.W. 1.—Brochure describing the Wellman mechanical gas producer, type "L."

DAVIDSON AND CO., Ltd., Sirocco Engineering Works, Belfast.—Brochure entitled "Achievement," showing some results obtained with Davidson patented flue dust collectors.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Catalogue illustrating the various applications of the firm's industrial turbine vacuum cleaner.

WINGET (1924), Ltd., Winget House, Grosvenor-gardens, S.W. 1.—Catalogue M-6, describing the "Winget" open drum concrete mixer, with the Burn-Lancaster special drum.

BUDENBERG GAUGE COMPANY, Ltd., Broadheath, Manchester.—Folder illustrating a patented time punch now being fitted to recording instruments having a circular chart.

SULLIVAN MACHINERY COMPANY, Salisbury House, London-wall, E.C. 2.—Bulletin 81-I giving particulars of "Sullivan" concrete breakers; Bulletin 76-G dealing with electric portable hoists.

BROOK MOTORS, Ltd., Empress Works, Huddersfield.—Booklet No. 157, describing "Brook" loom motors, and List No. 164, dealing with the hire purchase plan and prices for motors.

THE COMBUSTION ENGINEERING COMPANY, Madison-avenue, 35th to 36th-streets, New York, U.S.A.—Particulars of the building of the Kits Bay Station of the New York Steam Corporation.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, Ltd., 170, Piccadilly, London, W. 1.—Catalogue S. P. 102, second edition, dealing in full with "Boyer" pneumatic tools for road construction.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Brochure dealing with electrification work carried out on the Great Indian Peninsula Railway; also general descriptive catalogue for electrical contractors.

THE SKEFKO BALL BEARING COMPANY, Ltd., Luton, Beds.—The first two issues of the *Ball Bearing Journal*, a publication to give machinery users the benefit of the firm's experience in anti-friction engineering.

THE SUPERHEATER COMPANY, Ltd., 195, Strand, W.C. 2.—The following pamphlets, "M.L.S. Anti-carbonising Jet for Locomotives"; "Modern Locomotive Superheating," Part III.; "The M.L.S. Sand Gun."

LAUNCHES AND TRIAL TRIPS.

ITAPE, motor ship; built by Wm. Beardmore and Co., Ltd., to the order of Companhia Nacional de Navegacao Costeira, Rio de Janeiro; dimensions, 370ft. by 52ft. by 26ft. 9in.; to carry 3800 tons deadweight. Engines, twin-screw Beardmore Tosi four-cycle single-acting oil engines, 26in. diameter, 43½in. stroke, designed to develop a total of 3600 B.H.P. when supercharged; constructed by the builders; launch, June 2nd.

PAUA, twin-screw motor vessel; built by Harland and Wolff, Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd.; dimensions, 205ft. by 36ft. 6in. by 15ft.; to carry oil in bulk. Engines, one four-stroke cycle, six-cylinder Harland B. and W. Diesel engine; delivered to the owners June 9th.

PORT HUON, twin-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Commonwealth and Dominion Line; dimensions, 500ft. by 63ft. by 43ft. Engines, two sets oil-driven engines of the Wallsend-Sulzer two-stroke cycle design; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, June 9th.

STEEL LIGHTERS, 788 G and 789 G; built by Harland and Wolff, Ltd, to the order of Elder Dempster and Co., Ltd, for loading owners' vessels on West Coast of Africa; dimensions, 65ft. by 16ft. by 6ft.; to carry 85 tons deadweight capacity; launch, June 9th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

AUTOMATIC AND ELECTRIC FURNACES, Ltd., of 173-175, Farringdon-road, London, E.C. 1, asks us to announce that it has entered into an arrangement with G. Blundell and Co., Ltd., of Yokohama, for the sale of Wild-Barfield electric furnaces in Japan.

MR. G. PARKER PEARSON, Chartered Civil Engineer, of Dallas Chambers, Chippenham, asks us to state that he has entered into partnership with Mr. H. Ross Hooper, M. Inst. C.E., who has consequently resigned his appointment of Engineering Inspector on the staff of the Ministry of Health.

MR. FRED. W. DAVIES asks us to announce that he has relinquished his position as manager to T. W. Broadbent, Ltd., which he held for more than twenty years, and has established himself at Electrical Maintenance Works, Colne-road, Huddersfield, where he intends to carry on a general consulting practice.

THE MIRRLEES WATSON COMPANY asks us to announce that the fire which occurred at its works on June 6th was much less serious than was reported. It was confined to a certain number of patterns stored in an open yard. The main pattern stores, which are fireproof, and the pattern shop were practically untouched. No machinery was affected, and the works continued in full operation without interruption.

THE COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, Ltd., announces that, following upon the resignation, after nearly thirty years' service, of Mr. F. C. McQuown, joint manager and secretary of the company, Mr. H. W. Sprunt, M.I.E.E., M.I.Mech. E., has been appointed commercial manager, and Mr. John C. Dalton has been appointed secretary. The company also asks us to announce that its registered office has been changed from Moorgate-court, Moorgate-place, London, E.C. 2, to County House, 46-47, New Broad-street, London, E.C. 2. Telephone numbers and telegraphic address will remain unchanged, viz.:—Telephone: London Wall 3040; telegraphic address: Partnership, Ave, London.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, June 13th, Sir Arthur Keith, Treasurer and Vice-President, in the chair. The special thanks of the members were returned to Mrs. Baden-Powell for her present of a number of specimens of quartz. Sir Robert Waley Cohen, Mr. T. H. Hutcheson, Miss M. P. Lewis, Colonel T. H. Minshall, and Mr. C. E. Mott were elected members.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 3 0	—
No. 1 Foundry	4 6 6	—
No. 3 Foundry	4 1 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 17 6	3 17 6
No. 1	3 18 0	3 18 0
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 5 0	—
Forge	3 2 6	—
(3) Derbyshire—		
No. 3 Foundry	3 10 0 to 3 12 6	
Forge	3 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	3 12 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 11 6 (a) / 4 14 6 (b) / 4 18 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0	—
MIDLANDS—		
Crown Bars	10 15 0 to 11 0 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 5/16 in. to ½in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	8 15 0	—
,, (Small Round)	9 2 6	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 5 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 5 0 to 7 10 0	
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 10 0	
Billets and Sheet Bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 12 6 to 14 15 0	
Angles	7 12 6	—
Joists	7 12 6	—
Toes	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/- to 19/3
Block Tin (cash)	294 17 6
,, (three months)	286 12 6
Copper (cash)	54 10 0
,, (three months)	55 2 6
Spanish Lead (cash)	24 11 3
,, (three months)	24 17 6
Spelter (cash)	29 1 3
,, (three months)	28 18 9
MANCHESTER—	
Copper, Best Selected Ingots	59 10 0
,, Electrolytic	60 12 6
,, Strong Sheets	84 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	26 5 0
,, Foreign	25 0 0
Spelter	29 5 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	13/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 5 0 scale 8/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/-
,, ,, Ell	14/-
,, ,, Splint	15/6 to 17/-
,, ,, Trebles	14/6
,, ,, Doubles	13/- to 13/6
,, ,, Singles	13/- to 13/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/9
,, ,, Jewel	15/6
,, ,, Trebles	14/3 to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/3 to 13/6
Screened Navigation	18/- to 19/-
Trebles	14/6 to 15/3
Doubles	13/3
Singles	12/9 to 13/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/6
Trebles	14/6
Doubles	13/3 to 13/6
Singles	13/-

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	27/6
Household	42/6 to 58/6
Coke	26/- to 27/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	13/9 to 14/-
Steam Smalls	10/6
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	16/6 to 17/-
Second	14/3 to 14/9
Household	21/- to 27/-
Foundry Coke	23/6 to 26/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	27/6 to 28/6	
Best Selected House Coal	21/- to 22/6	—
Screened House Coal	19/- to 21/-	—
,, ,, Nuts	16/- to 17/6	—
Yorkshire Hards	16/- to 17/-	—
Derbyshire Hards	16/- to 17/-	—
Rough Slacks	10/6 to 11/6	—
Nutty Slacks	8/- to 9/-	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	22/- *	—
,, ,, (Export)	f.o.b.	17/6 to 18/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	21/- to 22/-
Second ,, ,,	20/- to 21/-
Best Dry Large	20/- to 20/6
Ordinary Dry Large	18/6 to 19/6
Best Black Vein Large	20/- to 20/6
Western Valley Large	19/- to 19/6
Best Eastern Valley Large	18/6 to 19/-
Ordinary ,, ,,	17/6 to 18/-
Best Steam Smalls	14/- to 14/6
Ordinary Smalls	12/- to 14/-
Washed Nuts	18/- to 21/6
No. 3 Rhondda Large	21/- to 22/-
,, ,, Smalls	16/- to 17/-
No. 2 ,, Large	18/- to 18/6
,, ,, Through	16/- to 16/6
,, ,, Smalls	13/- to 13/6
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	30/- to 32/6
Patent Fuel	25/- to 26/-
Pitwood (ex ship)	30/- to 30/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	40/- to 42/6
Seconds	30/- to 37/-
Red Vein	25/- to 30/-
Machine-made Cobbles	45/- to 47/6
Nuts	42/6 to 45/-
Beans	30/- to 35/-
Peas	19/6 to 22/-
Breaker Duff	8/- to 9/-
Rubbly Culm	10/9 to 11/3
Steam Coals :	
Large	21/- to 22/-
Seconds	18/6 to 20/6
Smalls	11/- to 12/-
Cargo Through	16/- to 17/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Industry.

THE failure to get higher prices has accentuated the depression in the steel trade, for it is evident that consumers will not be tempted to buy under threat of paying more for their material, and it is certain that the home consumption is at present so small that there can be no hope of a recovery in the early future. Business for export is restricted, and there appears little prospect of any great improvement in this direction in view of the partial closing of markets in the Far East. Competition is therefore increasing and prices are weakening all round. In Brussels business has been done at £4 13s. for girders, £4 14s. to £4 15s. for bars, £4 4s. to £4 5s. for blooms, and £4 7s. to £4 8s. for billets. At the meeting in Luxemburg of the Steel Cartel it was decided to make no change in the production during the third quarter of the year, and German steelmakers obtained partial satisfaction over the indemnities to be paid for an excess of the allotted quota on the understanding that they should not supply steel for export. The German demand absorbs all that the home firms are producing. Representatives of Polish steelmakers were present at the meeting with a proposal for entering the Steel Cartel, and the matter has been referred for consideration to a special Commission. In the engineering industries the situation remains unsatisfactory, except for those which have secured contracts from the railway companies and from the Marine.

Two Concrete Bridges.

In view of the construction of the Sautet barrage across the Upper Drac, in Isère, the existing suspension bridge, which is below the level of the proposed reservoir, is to be replaced by one of reinforced concrete at a greater altitude. The distance between the abutments of the span is 280ft., and the length of the deck will be 393ft. and the width 19ft. 8in. The height from the bottom of the gorge is 525ft. The bridge will be completed by the end of the year. The construction of the barrage will be undertaken by the Société des Forces Motrices Bonne et Drac, which was constituted by a number of big power users, including the Aciéries de Saint-Etienne, the Etablissements Marrel and the Hauts Fourneaux de Chasse. In order to allow of the construction of the dam, the State abandoned the power station it was creating at Pont-du-Loup, which would have been submerged in the artificial lake. The barrage will close up the gorge of the Drac at Sautet to a height of 440ft. The other concrete bridge is being constructed over a gorge at La Caille, in Upper Savoie, at a height of 480ft. above the Usses torrent. It is being built close to a very old suspension bridge which is regarded as no longer safe for traffic. The length of the span is 460ft. and the total length of the deck is 750ft.

Tidal Power.

The scheme for constructing an experimental tidal power station at Aber W'rach has been held up for a considerable time on account of financial difficulties, but now that the original company has been reconstructed under the name of the Société d'Entreprises Hydrauliques et d'Utilisation Industrielle des Marées there is some prospect of more progress being made in the early future. A Bill authorising the carrying out of the scheme was passed in October, 1923, and subsidies were granted by the State and by the department of Ile et Vilaine. When visiting Saint-Malo to initiate the works for the construction of the new port, the Minister of Public Works visited Port-Saint-Jean, about six miles from the mouth of the Rance, where the river water is to be held up by a dam to supply energy in conjunction with the tidal power station which will be constructed later on at Aber W'rach. The object of combining the fresh water plant with the tidal power scheme is to ensure a continuous distribution of electrical energy. The maximum difference between high and low water on this part of the coast is 46ft., and it is estimated that when the whole scheme is completed there will be available 450 million kilowatt hours per year.

Coal Import Licenses.

Following upon the protests that have been made by many classes of the community against the prohibition of coal imports, except by license, the Association of French Ports has passed a series of resolutions requesting the Government to withdraw the new decree and at the same time suppress the various measures which have been taken on behalf of French coalowners, notably the preferential railway rates for French coal which are declared to be detrimental to the interests of the railways, railway users, navigation companies and the maritime ports. The Association further insists that, in the interests of consumers, nothing should be done to interfere with competition, and that, moreover, something should be done to enable French vessels to secure a larger share of the coal carrying trade to French ports. It is understood that all these protests have had some effect in inducing the Government to place as few obstacles as possible in the way of granting import licenses. It is generally believed that a great mistake has been made in attempting to restrict the importation of raw material under conditions which are bound to increase the price in this country, and although it is hardly possible to withdraw all the advantages recently accorded to French coalowners it is hoped that the decree will be applied with sufficient tolerance to ensure an adequate importation of coal.

The "Ile de France."

The largest Transatlantic steamer yet constructed in France will be put in service this month by the Compagnie Générale Transatlantique between Havre and New York. The vessel is a development of the Paris, but much larger, its length being 241 m., and width 28 m., and displacement 43,500 tons. The engines are of 52,000 horse-power. Particular care has been taken with the arrangement, decoration and fittings of the Ile de France, which make it one of the most luxurious ships afloat.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

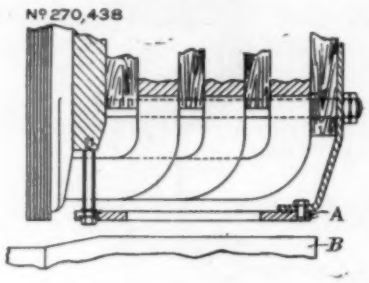
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

270,438. February 19th, 1926.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, John Sedgwick Peck, of "Schenley," Bentinck-road, Altrincham, Chester; Jan Arthur Kuyser, of "Knowle Lodge," Sibson-road, Sale, Chester; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, Westminster.

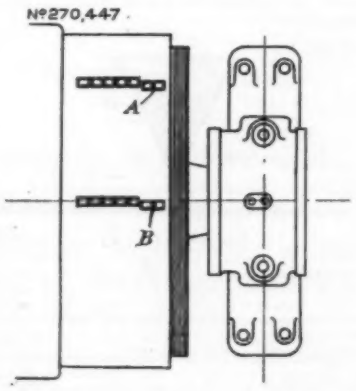
It has been found with certain forms of stator windings that the magnetic field passing principally from the rotor surface to the end face of the stator may lead to undesirable heating of that



part of the stator copper which is external to the core. According to the invention, a stationary electro-magnetic shield A of non-magnetic material of high electrical conductivity, such as copper, is placed between the stator bar extensions or end connections or both and the cylindrical portion of the rotor B which extends outside the stator core. By these means paths of adequate electrical conductivity are provided for the circulating currents, the heat induced in the shield being readily dissipated. The shield may take a number of different forms.—*May 12th*, 1927.

270,447. February 27th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL MACHINES WITH COMMUTATORS, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2; and Arthur Ernest Angold, of The General Electric Company, Ltd., Witton Engineering Works, Witton, Birmingham.

The object of this invention is to minimise the destructive effects of arcs which are formed between commutator segments

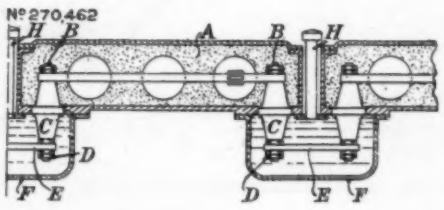


and which sometimes extend to the brush gear and other parts of the machine when the commutator "flashes over." According to the invention, one or more brushes of each set near the outer end of the commutator breaks contact with any commutator segment later than the other brushes break contact, and the tendency to arc over is localised at these brushes. In the illustration the outer pair of brushes A and B are advanced with respect to the other brushes.—*May 12th*, 1927.

SWITCHGEAR.

270,462. March 23rd, 1926.—IMPROVEMENTS RELATING TO SECTIONAL ELECTRICAL BUS-BARS, David Reginald Davies, of 14, Ruabon-road, Didsbury, near Manchester; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, in the City of Westminster.

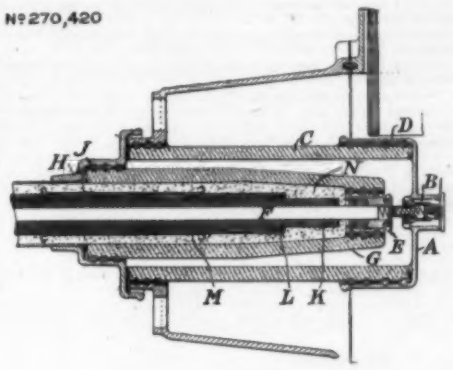
The conductor forming a bus-bar section is enclosed in a metal casing filled with insulating compound A. The leads B attached



to the end of the conductor are encased in rigid insulators C which project through holes in the under side of the casing and are provided with terminals D connected to bus-bar links E enclosed in coupling boxes F filled with oil, through tubes H, with a sight-feed device at the top. With this arrangement the connection or disconnection of additional bus-bar sections is a very simple matter, for it is only necessary to draw off the liquid from the coupling boxes, after which they can be removed or opened and the link between the bus-bar sections can be disconnected.—*May 12th*, 1927.

270,420. February 9th, 1926.—IMPROVEMENTS RELATING TO HIGH-POTENTIAL INSULATED CONDUCTORS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Herbert Christopher Heath, of 51, Kingsway, Wembley, Middlesex.

This invention relates to high-potential conductors supported in bushings with an annular air space around the bushing, and particularly to such high-potential conductors as form part of an isolating device in switchgear. The object of the invention is to reduce or entirely prevent a discharge through the air space.

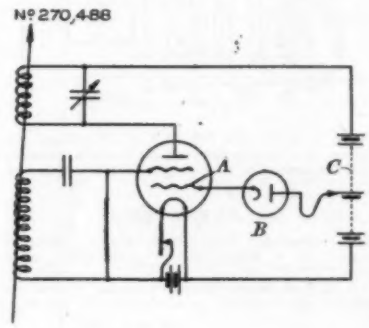


An arrangement of a plug and socket forming an isolating device or a truck or draw-out switch is shown. The fixed frame A carries a spring-pressed plunger B within the hollow cylinder C to which it is connected at D. The co-operating contact E is carried at the end of the conducting rod F mounted in an insulator G secured in the movable frame H with cement J. The connecting-rod F is surrounded by insulating tubes K and L, and at M there is an earthing sheath connected to the movable frame H. The space within the insulator G may be filled with compound N. The object of the earthing shield is to prevent corona discharge.—*May 9th*, 1927.

TELEGRAPHS AND TELEPHONES.

270,488. May 6th, 1926.—IMPROVEMENTS IN OR RELATING TO CIRCUIT ARRANGEMENTS FOR GENERATING ELECTRIC OSCILLATIONS, *Harold Wade, of* 111–112, *Hatton-garden, London, E.C.* 1.

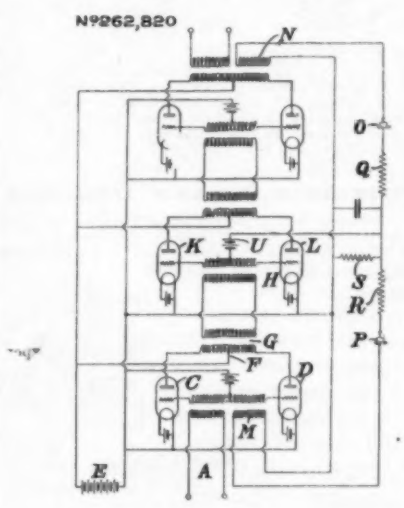
The valve of the oscillating circuit has a controlling grid and



a space charge grid A, and the connection between the battery C and this grid is made through a two-electrode valve B comprising an incandescent electrode and a cold electrode in order that the inner grid currents may be limited to the saturation current of the valve B.—*May 12th*, 1927.

262,820. December 13th, 1926.—IMPROVEMENTS IN OR RELATING TO THERMIONIC AMPLIFIERS, MODULATORS, DETECTORS AND LIKE DEVICES, *Marconi's Wireless Telegraph Company, Ltd., of Marconi House, Strand, London, W.C.* 2.

This invention relates to thermionic amplifiers, detectors, modulators and, in general, any device employing thermionic valves in which it is desirable that the input should bear a



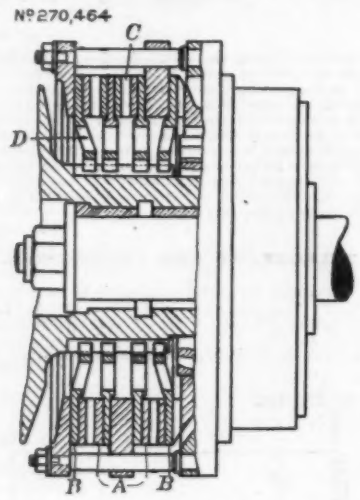
definite relation to the output. In particular, the invention relates to the control of the ratio between the input to the output, so that a true reproduction of the input will result. The causes of the non-linear characteristics of ordinary amplifiers are set forth in the specification. The method of eliminating or very greatly reducing the departure from a non-linear characteristic consists in automatically causing the amplification of

one or more stages of an amplifier system to be varied by means of the grid bias, so as to keep a constant ratio between the input and output amplitudes of the amplifier system. In the diagram the terminals of the input transformer are shown at A, and it will be seen that the transformer is coupled to the grids of the valves C and D. The middle point of the secondary winding is connected to a bias battery, and the plates of the valves are energised by the high potential battery E, through the connection F of the transformer G. The oscillations thus produced pass through the transformer H to the amplifying valves K and L, and it will be seen that the same process of connections is repeated. The first input transformer and last output transformer are coupled by windings M and N, which are connected together, so as to be approximately in phase with one another, through rectifiers O and P, and resistances or reactances Q and R. A resistance or reactance is also connected across the transformer windings N and M at the point S, and a condenser is similarly connected for dealing with the high frequencies. The bias produced by the battery U on the grids of the valves K and L is modified by any potential difference across the reactance S. The number of turns on the coils M and N is selected so that with the normal amount of amplification there will be no flow of current through S. If more current is passed through O than through P, a potential difference will exist in one direction across S, whilst if more current passes through P than through O a reverse potential will exist. Thus the bias produced by the battery U will be added to or subtracted from by the amount of potential difference across S and in direct ratio to the amount of power in balance between the coils M and N.—*May 5th*, 1927.

TRANSMISSION OF POWER.

270,464. March 25th, 1926.—FRICTION CLUTCHES, H. H. Benn, Templewood, Farnham Common, Bucks.

In order to dissipate the heat generated when a friction clutch is allowed to slip, the inventor arranges for the circulation of

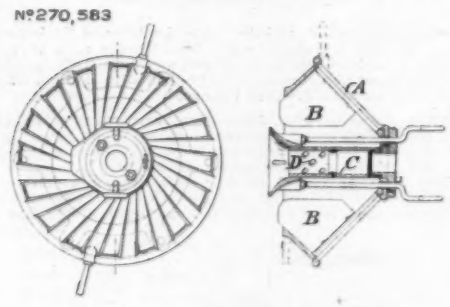


air through it under the influence of centrifugal force. The driven plates A A have radial passages B, while the driving plates C have axial openings D for the ingress of air.—*May 12th*, 1927.

FURNACES.

270,583. November 26th, 1926.—LIQUID FUEL FURNACE FRONTS, W. A. White, Prince Consort-road, Hebburn-on-Tyne.

In this oil fuel burner the air necessary for combustion is admitted through a conical gridiron valve A, the edges of the

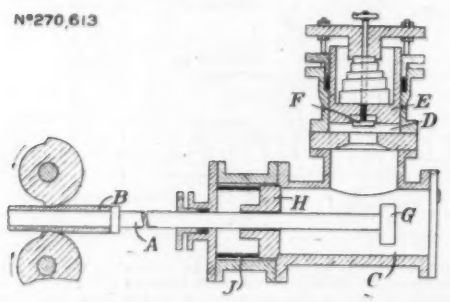


orifices of which are bevelled to give a whirling motion to the air. Helical buffers B B help to maintain the whirl. The burner jet is arranged in the tube C and holes D admit a certain amount of air directly to the jet. The bell mouth is adjustable axially.—*May 12th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

270,613. February 10th, 1927.—PILGER ROLLING MILLS, E. Röber, Hindenburg Wall 24, Düsseldorf, Germany.

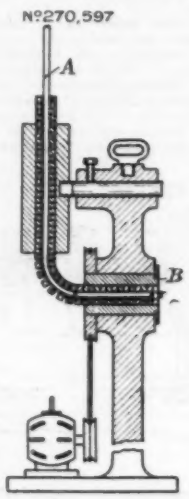
In the Pilger process of tube rolling there is a tendency for



the mandrel A carrying the tube B to "pump" backwards and forwards at the end of every stroke, on account of the resilience of the springs generally used to arrest its forward movement. The inventor overcomes the trouble in the following manner. The mandrel is extended into a hydraulic cylinder C which communicates with a secondary cylinder D furnished with a spring-loaded piston E. The communicating passage can be controlled by the valve F. On the return stroke of the mandrel, when the rolls are at work, water is displaced into the cylinder D and compresses the spring. When the rolls lose their grip on the tube the spring pushes the mandrel forward again until the head G meets the loose piston H. Any forward movement of this piston is checked by a spring J so formed that internal friction reduces its rebound to a minimum.—*May 12th*, 1927.

270,597. December 20th, 1926.—SCREWING NUTS ON TO BOLTS, A. de Fries, 10, Lessingstrasse, Cassel, Germany.

This machine is intended for screwing nuts on to bolts temporarily, not necessarily for tightening them up. The nuts are threaded on to a rod A which starts vertically and leads into the horizontal bore of a holder B. This holder is driven as shown by

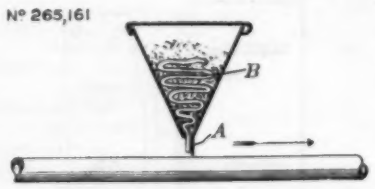


an electric motor or any other convenient means. At the front end of the holder there are springs which prevent the nuts dropping out, although they tend to feed forward under the weight of the pile on the rod A. If a bolt is offered up to the end of the holder the first nut will be screwed on to it and the nut can then be pulled out of the holder in opposition to the retaining springs.—*May 12th*, 1927.

MISCELLANEOUS.

265,161. December 31st, 1926.—SEVERING GLASS RODS AND TUBES, Société du Verre Sili-Chrome, 65, Rue d'Hauteville, Paris, France.

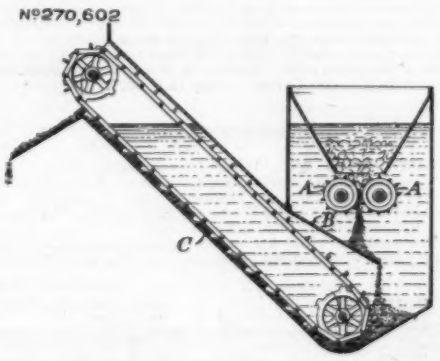
Instead of using a knife for cutting off lengths of glass rod or tube as it issues continuously from the producing machine, the inventors propose to effect the severance by local cooling of the hot glass and consequently cracking it. This cooling is effected



by the device A, which is kept cool by an asbestos wick B saturated with water. The contacting part of A is shaped to embrace half the circumference of the tube and the device is moved forward while it is in contact to keep pace with the feed of the tube. It is, however, suggested that the period of contact necessary for severing the tube is so short that this movement may be unnecessary.—*April 28th*, 1927.

270,602. January 7th, 1927.—COAL CRUSHERS, P. G. Siegle and G. E. Dean, 512, Third-street, Dunmore, Lackawanna, Pennsylvania.

The inventors aim at the breaking of coal with the production



of a minimum of fines, and to this end submerge the breaking rolls A A in a tank of water. The broken coal drops on to a baffle B and thence into the boot of a conveyor C, which delivers it to any convenient place.—*May 12th*, 1927.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—The next examinations for Garduateship and Associate-Membership of the Institution of Structural Engineers will take place in London, Bombay, and such other centres as may be arranged on Wednesday, July 6th; Thursday and Friday, July 7th and 8th. A syllabus and form of entry may be obtained from the secretary, Mr. Maurice G. Kiddy, F.I.S.A., 10, Upper Belgrave-street, S.W. 1. The closing date for entries is June 29th.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, JUNE 18TH.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—In the Lecture Theatre of the Institute, Newcastle-upon-Tyne, for the purpose of receiving the nomination list of officers of the Institute for the ensuing year. 2.30 p.m.

THE INSTITUTION OF ENGINEERS-IN-CHARGE.—Visit to the *Daily Sketch* works, 200, Gray's Inn-road, W.C. 1. 4 p.m.

MONDAY TO WEDNESDAY, JUNE 20TH TO 22ND.

THE INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer meetings at Bournemouth.

MONDAY TO THURSDAY, JUNE 20TH TO 23RD.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Joint summer meeting in Glasgow with the Institution of Engineers and Shipbuilders in Scotland. June 21st, "Historical References to the Progress in the Use of High-pressure Steam," by Mr. James Mollison; "The Trade Value of Simplification and Standardisation in the Details of Ships and their Machinery," by Mr. C. Le Maistre. June 22nd, "Economy in Shipbuilding: Some Lines of Progress," by Mr. John McGovern; "Motor Yachts and Motor Yachting on the Clyde," by Mr. F. L. MacLaren.

TUESDAY, JUNE 21ST.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, 5, John Dalton-street, Manchester. Ordinary meeting at 4 p.m.

WEDNESDAY, JUNE 22ND.

INSTITUTION OF MECHANICAL ENGINEERS.—North-Western Branch. Visit of inspection to the works of Metropolitan-Vickers Electrical Company, Ltd., Trafford Park. 2 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit of inspection to the works of Mather and Platt, Ltd., Newton Heath. 2.30 p.m.

THE INSTITUTION OF WELDING ENGINEERS.—At the Engineers' Club, Coventry-street, London, W. 1. Lecture: "The Red-Shortness of Weld Metal," illustrated by lantern slides, by Mr. A. H. Goodger. The lecture will be followed by a discussion. 8 p.m.

TUESDAY, JUNE 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Visit to the Kent Cement Works at Greenhithe by steamer, which will start from Westminster Bridge Pier at 10 a.m.

WEDNESDAY TO FRIDAY, JUNE 29TH TO JULY 1ST.

INSTITUTION OF MINING ENGINEERS.—Summer meeting at Newcastle-on-Tyne.

SATURDAY, JULY 2ND.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the Castleton Works of Messrs. Tweedale and Smalley.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Town Hall, St. Annes-on-Sea. North-Western District meeting. 10.30 a.m.

CONTRACTS.

ALLEN LIVERSIDGE, Ltd., Victoria Station House, Westminster, S.W. 1, has secured an order from the Tramways Department of the London County Council for a further twelve A-L "Pontelec" electric rail grinders.

NEGRETTI AND ZAMBRA, of 38, Holborn-viaduct, London, E.C. 1, ask us to state that the temperature indicators and recorders on the boilers at the Stourport electric generating station, which were referred to in our issue of June 10th, were all supplied by them and constructed on their patented mercury-in-steel principle.

BLAKEBOROUGH AND SONS, Ltd., of Brighouse, Yorks., inform us that, for the protection against fire of the new Grand Stand on Epsom Racecourse, they supplied the main hydrants, six in number, outside the Grand Stand, the main gun-metal fire valves on the Stand—of which there are twenty—six hose cabinets containing lengths of hose, stand pipes, hand pipes, keys, &c. The fire protection equipment provided for the Stand by Merryweather and Sons, Ltd., of Greenwich, which was referred to in our last issue, comprised 3000ft. of "Dub 8ub" canvas hose in lengths of 50ft., each fitted with gun-metal couplings, together with fifteen branch pipes and nozzles, mounted on boards.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., has, following on the order recently placed with it by the Liverpool Corporation for a second 25,000 kW. turbo-alternator set for the Lister Drive No. 3 Power Station, received further orders covering the transformers and switchgear for the extensions in that power station and for the reconstruction of three sub-stations. The transformer contract covers the supply of eight 10,000 kVA. three-phase core-type units for new feeders. Two of the units are designed for 6300/33,000 volts operation, the other six new units being for 6300/22,000 volts. The switchgear contract provides for a 19-cubicle extension to the 6300 volt switchboard in the power station, 19 6300 volt circuit-breakers for Lark-lane sub-station, 14 for Beaumaris-street sub-station, and 16 for Garston sub-station, together with auxiliary switchgear and spares in each case.

DRAWN STEEL REINFORCEMENT BARS.—The revision of the British Standard Specification No. 15, 1912, Structural Steel for Bridges and General Building Construction, has been engaging the attention of the Association for some time past, and at the instance of the Institution of Structural Engineers it has been agreed that consideration shall be given to the preparation of a B.S. specification for drawn steel bars for reinforced concrete construction, which have not up to the present been dealt with by the British Engineering Standards Association.